(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 004 351 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
31.05.2000 Bulletin 2000/22

(21) Application number: **97927445.3**

(22) Date of filing: **20.06.1997**

(51) Int. Cl.[7]: **B01F 5/00**

(86) International application number:
PCT/JP97/02174

(87) International publication number:
WO 98/58730 (30.12.1998 Gazette 1998/52)

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

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(54) STATIC FLUID MIXER

(57) The present invention provides a static fluid mixer which is remarkably easily assembled, facilitates machining of the inner circumferential surface of the casing to reduce production costs, prevents vibrations of mixing elements, and further improves insufficiency in mixing due to short-circuited flows generated by leakage. The mixing assembly element 5 internally incorporated in the casing 4 is constructed of an annular sealing unit 8 formed of a resilient material, and mixing elements 9, whereby the annular sealing unit 8 forms a cylindrical body by a resilient material with the outer diameter which can be inserted into the casing 4, flanges are formed inward of both ends of the cylindrical body, and the mixing element 9 is constructed so that two large and small disks arrayed in a plurality and having small chambers formed at the front thereof are provided as a set and these are internally incorporated in the annular sealing unit 8 by causing these to overlap each other concentrically.

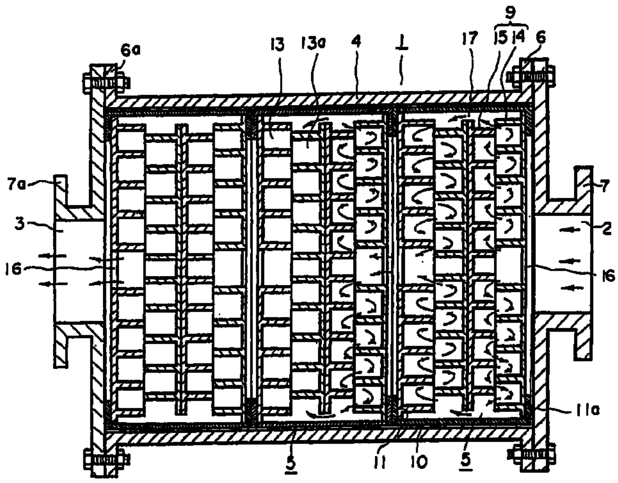

Fig. 1

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Description

Technical Field of the Invention

[0001] The present invention relates to a static fluid mixer not having any mechanical moving parts.

Background arts

[0002] Conventionally, a fluid mixer disclosed by Japanese Patent Laid-Open Patent Publication No. 133822-1983 was publicly known as a type of a static fluid mixer. Such a static fluid mixer consists of a cylindrical casing provided with an inlet and an outlet at either end thereof, and a plurality of fluid mixing elements composed so that two large and small disks, in which a number of polygonal small chambers, respectively, having a forward open side at the faces opposed each other, are arrayed like a honeycomb so as to be concentric to each other, wherein the large disk has a diameter coincident with the inner diameter of the casing and has a circulating port prepared at the center thereof, and the large disk and small disk are arrayed so that the positions thereof are changed so that the respective small chambers thereof can communicate with the other plurality of small chambers opposed thereto. And, a plurality of these fluid mixing elements are caused to overlap so that the disks of the same diameter are adjacent to each other, and are disposed in the casing, and at the same time, the large disks of the fluid mixing elements are positioned at both sides thereof, wherein the communicating ports are also caused to communicate with the inlet and outlet of the casing.

[0003] And, where a fluid to be mixed is caused to flow from the inlet into the interior space under pressure, the fluid reaches the interior through the circulating ports of the fluid mixing elements at the upstream side, changes the flow direction since the straight flow course is hindered by small disks communicating with each other, and unevenly and radially flows from the middle port toward the outside through small chambers communicating with each other. Then, the fluid which reaches the inner circumferential surface of the casing, passing through the upstream side fluid mixing elements, enters respective small chambers of the downstream side fluid mixing elements from flow paths formed by the inner circumferential surface of the casing and the small disks, further flows in the middle portion, and again enters the downstream side fluid mixing elements from the flow paths. Here, the fluid unevenly circulates in the interior of the fluid mixing elements one after another from the middle portion toward the outside, passing through the respective small chambers, and finally is discharged from the outlet.

[0004] However, since a disk of a large diameter is provided with a sealing function so that the outer diameter thereof is made close to the inner diameter of the casing, it is necessary to precisely machine the inner diameter of the casing and the outer diameter of the disk of a large diameter, and the casing requires some length to array a plurality of fluid mixing elements. Therefore, it becomes difficult to precisely machine the inner diameter of the entire length of the casing. Further, since the outer diameter of the disk of the large diameter is in only close contact with the inner diameter of the casing, the inner diameter may be enlarged since the casing is strained as the supply pressure of a fluid is increased, whereby slight clearance is produced partially between the outer diameter of the disk of the large diameter and the inner diameter of the casing, and the fluid may flow out to the outlet side by short-circuiting through such clearance without being subjected to any mixing action along the entire length of the inner circumferential surface. Such a problem arises, in which the regular mixing efficiency is reduced.

[0005] It is therefore an object of the invention to provide a static fluid mixer which is constructed so that it is simple to assemble the mixer, machining of the inner circumferential surface of the casing is facilitated by roughing the machining accuracy to reduce production costs, vibration of mixing elements is prevented from occurring, and a mixing insufficiency due to short-circuiting flows generated by leakage of the fluid can be improved.

Disclosure of the invention

[0006] In view of the difficulty of accurate machining on the basis of the prior arts and a theme of improving upon the lowering of efficiency due to short-circuit flows, the invention provides a static fluid mixer in which mixing assembly elements internally secured in the casing are composed of an annular sealing unit formed of a resilient material and mixing elements, and which has objects of eliminating a short-circuiting flow and of facilitating the machining thereof, whereby the abovementioned shortcomings and problems can be solved.

[0007] The static fluid mixer is composed of a casing, a cover member, and mixing assembly elements, the casing is formed cylindrical, and a covering member is detachably attached to the inlet and outlet secured at both sides.

[0008] The mixing assembly elements are composed of an annular sealing unit and mixing elements internally secured in the annular sealing unit, wherein the annular sealing unit forms a cylindrical body made of a resilient material, with the outer diameter thereof idly inserted in the casing, and has a flange integrally formed inwardly at both sides.

[0009] The mixing elements are composed of a pair of two large and small disks which have a number of small chambers, whose ends are opened forward, arranged on their front surfaces opposed each other, and the pair of two large and small disks are caused to overlap concentrically, wherein the large diameter disk is formed with a larger outer diameter rather than the inner circumference diameter of the flange at the annular sealing unit, and at the same time, has a fluid circulating pore prepared at the middle thereof, and the outer diameter side of the small disk is constructed so that a fluid circulating path is formed between the outer diameter side thereof and the inner circumferential surface of the cylindrical body. The small chambers of the large diameter disk and small chambers of the small diameter disk are caused to communicate with the other plurality of small chambers so that the respective small chambers are opposed to each other, and are arrayed with their position changed, so that crossing connection portions of side walls which form other small chambers are positioned at the center of the small chambers.

[0010] And, the mixing assembly elements have a large diameter disk of the mixing elements disposed at both sides in the annular sealing unit, and two small disks are arrayed therebetween. The mixing assembly elements are arrayed in a plurality in the casing, and are placed between the covering members at both sides of the casing, so that the flanges of the annular sealing units are resiliently deformed under compression.

[0011] Further, a packing having a communication portion formed at the middle thereof is caused to intervene in space inward of the flange portion of the annular sealing units at the mixing assembly elements arrayed in a plurality in the casing or between the space and the flange portion of the annular sealing unit, in a state where it is resiliently compressed and deformed when being attached thereat.

Brief description of the drawings

[0012]

FIG. 1 is a roughly longitudinally sectional view of a static fluid mixer according to the present invention,

FIG. 2 is a roughly longitudinally sectional view showing a state before a covering member is attached in the static fluid mixer,

FIG. 3 is a perspective disassembled view of mixing assembly elements which constitute the static fluid mixer,

FIG. 4 is a front elevational view of two disks which constitute mixing elements of the mixing assembly elements,

FIG. 5 is a perspective view of the same disks,

FIG. 6 is a view showing an arrayed state of respective small chambers for communication in a case where the two disks are arrayed concentrically,

FIG. 7 is a view showing an arrayed state thereof for communication where the shapes of the small chambers in the same disks are made triangular,

FIG. 8 is a view showing an arrayed state thereof for communication where the shapes of the small chambers in the same disks are made square,

FIG. 9 is a view showing an arrayed state thereof for communication where the shapes of the small chambers in the same disks are made octangular,

FIG. 10 is a roughly longitudinally sectional view of another preferred embodiment of a static fluid mixer according to the invention,

FIG. 11 is a roughly longitudinally sectional view showing a state before a covering member is attached in the static fluid mixer,

FIG. 12 is a perspective view showing mixing assembly elements and a packing member in the static fluid mixer,

FIG. 13 is a roughly longitudinally sectional view showing still another preferred embodiment of a static fluid mixer,

FIG. 14 is a roughly longitudinally sectional view showing a state before a covering member is attached in the static fluid mixer, and

FIG. 15 is a perspective view of mixing assembly elements and a packing member in the same static fluid member.

Best mode for carrying out the invention

[0013] A description is given of preferred embodiments of the invention with reference to the accompanying drawings.

[0014] A static fluid mixer 1 according to the invention internally has an appointed number of mixing assembly elements in a cylindrical casing 4 having an inlet 2 and an outlet 3.

[0015] Flange 6 or 6a protruding outward is formed at open portions at both ends of the casing 4, and covering members 7 or 7a having an inlet 2 and an outlet 3 formed, whose diameter is smaller than the inner diameter of the casing 4, is detachably mounted at the end faces of the flanges 6 and 6a.

[0016] Mixing assembly elements 5 are internally provided in the axial direction in the hollow internal portion of the casing 4, and such mixing assembly elements 5 are composed of annular sealing units 8 and mixing elements 9. The annular sealing units 8 are made of elastomer (nitril rubber, silicone rubber, fluorine rubber, thermoplastic elastomer, etc.) having rubber-like resiliency, which is a material property as a resilient body used for general sealing devices, and forms a cylindrical body 10 with the outer diameter to be idly inserted into the casing 4 with slight clearance, wherein flanges 11 or 11a are integrally formed from both ends of the cylindrical body 10 to be constituted as a ring-like member.

[0017] The mixing elements 9 are internally provided in the annular sealing unit 8, and as shown in FIG. 3 through FIG. 6, two large and small disks 14 and 15 are provided as a set, in which a number of small columnar chambers 13, 13a, etc., having a bottom, whose plan view is polygonal, which are opened forward and erect roughly at a right angle toward the front side, are arrayed adjacent to each other are arranged on the front side of disks opposed each other, and these disks are caused to overlap concentrically. And, two sets of such mixing elements 9 are internally provided in the annular sealing unit 8.

[0018] Further, the disk 14 of a large diameter is formed with a larger diameter rather than the inner circumferential diameter of the flanges 11 and 11a at the annular sealing unit 8, so that at least the inner face of the flanges 11 and 11a are provided so as to overlap on the rear side of the disk 14 on the outer circumferential side thereof, and preferably the outer circumferential end face of the disk 14 is formed at an outer diameter which can be brought into close contact with the inner circumferential face of the cylindrical body 10 of the annular sealing unit 8, whereby such contacted portions are made substantially fluid-tight (to seal fluids such as air and liquid), and a circulating pore 16 is prepared at the middle thereof. On the other hand, the outer diameter of the disk 15 of a small diameter is spaced from the inner circumferential face of the cylindrical body 10 at the annular sealing unit 8 and is sized so that a circulating path 17 can be formed between the outer diameter thereof and the corresponding inner circumferential face.

[0019] In addition, as shown in FIG. 6, the small chambers 13, 13a, etc., of the disks 14 of a large diameter and the small chambers 13, 13a, etc. of the disk 15 of a small diameter are caused to communicate with the other small chambers 13, 13a, etc., in which the respective small chambers 13, 13a, etc., are opposed each other, and are positioned with their positions changed so that the crossing connection portions of the side walls 12 which form other small chambers 13, 13a, etc., are located at the center of the small chambers 13, 13a, etc.

[0020] And, these two sets of mixing elements 9 have a large-diameter disk 14 disposed at both sides of the annular sealing unit 8, and further have two small-diameter disks 15 disposed therebetween, wherein two sets of mixing elements 9 and small disks 15 are internally provided in the annular sealing unit 8, thereby constituting a mixing assembly element 5.

[0021] Also, the length of the cylindrical body 10 of the annular sealing unit 8 in the axial direction thereof is made roughly coincident with the thickness in the axial direction in a state where four large and small disks 14 and 15 of the mixing elements 9 are caused to overlap each other concentrically.

[0022] Further, the abovementioned preferred embodiment shows an example in which small chambers 13, 13a, etc., whose plan view is hexagonal are arrayed in a plurality like a honeycomb. However, the shape is not limited to such a form. As shown in FIG. 7 through FIG. 9, the plan view of the small chambers 13, 13a, etc., may be triangular, square, octangular, or circular (not illustrated).

[0023] Next, a plurality of mixing assembly elements 5 are disposed in series in the internal hollow portion of the casing 4, wherein covering members 7 and 7a are mounted at the flanges 6 and 6a by tightening means such as bolts, nuts, etc., and a plurality of mixing assembly elements 5 are placed and fixed between the covering members 7 and 7a and are arrayed in the casing 4.

[0024] Herein, by setting the dimension L2 between both ends in a continuous state, where the mixing assembly elements 8 provided in a plurality are concentrically installed in a free state in a continuous state where the respective flanges 11 and 11a of the annular sealing unit 8 are brought into contact with each other, greater than the dimension L1 between both ends of the casing 4, a pressing force is applied to the respective flanges 11 and 11a of the annular sealing unit 8 at the respective mixing assembly elements 5. Therefore, the respective flanges 11 and 11a are resiliently compressed and deformed by the pressing force, and the respective upper end faces of the side walls 12 of the small chambers 13, 13a, etc., are pressed by the resiliency restoring force to cause the contacting state to be made satisfactory. Further, the flanges 11 and 11a of the annular sealing unit 8 are pressed to the rear side at the outer circumferential side of the large diameter disk 14 to cause the contacting state to be made satisfactory, whereby the sealing function will be completed.

[0025] Herein, the dimension of the inner diameter of the flanges 11 and 11a of the annular sealing unit 8 in the abovementioned preferred embodiment is established in relation to the material of the annular sealing unit 8 so that the mixing assembly elements 5 can be easily mounted substantially in a state where no cut is produced even at a part of the annular sealing unit 8 when the annular sealing unit 8 is resiliently deformed. As a detailed embodiment, the dimension of the inner diameter of the flanges 11 and 11a at the annular sealing unit 8 is set to approximately 90mm where the outer diameter of the large-diameter disk 14 is approximately 90mm and the thickness in the axial direction is approximately 25mm when four large- and small-diameter disks 14 and 15 are caused to concentrically overlap.

[0026] Next, in the abovementioned preferred embodiment, since the sealing portion at the rear side of the large diameter disk 14 is the outer circumferential side with which the flange portions 11 and 11a of the annular sealing unit 8 are in close contact, the flanges 11 and 11a at such portions are protruded, and there is a possibility for the sealing to become insufficient. Therefore, another preferred embodiment is provided to solve such insufficient sealing. As shown in FIG. 10 through FIG. 12, a packing member 18 is caused to intervene in a space inward of the flanges 11 and 11a of the annular sealing body 8 at the mixing assembly element 5 internally incorporated in the casing 4, wherein there are two types of packing members 18, one of which is an intermediate packing 19 intervening between the mixing assembly elements 5, and end packing 20 intervening between the mixing assembly elements 5 and the covering members 7 and 7a.

[0027] The intermediate packing 19 is made of a resilient body similar to that of the annular sealing unit 8. Columnar portions 22 and 22a which have a slightly smaller diameter than the inner diameter of the flanges 11 and 11a of the annular sealing unit 8 are caused to protrude from and formed at both sides of a disk body 21 which has a larger diameter than the inner diameter of the flanges 11 and 11a of the annular sealing unit 8 and a smaller diameter than the inner diameter of the casing 4, and at the middle portion thereof, a communication pore 23 which is constituted so as to have roughly the same diameter as that of the circulating pore 16 being formed at the large diameter disk 14.

[0028] The end packing 20 is such that only either one of the columnar portions 22 and 22a of the intermediate packing 19 is not produced, and the disk bodies 21 of the end packing 20 may be caused to overlap each other so as to constitute an intermediate packing 19.

[0029] Further, in the abovementioned embodiment, the intermediate packing 19 and end packing 20 are formed so as to have a portion which is placed and nipped between the flanges 11 and 11a of the mixing assembly elements 5. However, these packings may not be limited to this shape. As shown in FIG. 13 through FIG. 15, those in which a communication pore 23 is formed at the middle of the disk body 21 which has a slightly smaller diameter than the inner diameter of the flanges 11 and 11a of the annular sealing unit 8 may be used as the intermediate packing 19 or the end packing 20.

[0030] Herein, by setting the dimension L2 larger than the dimension L1 between both ends of the casing 4 where the annular sealing unit 8, intermediate packing 19 and end packing 20 are concentrically constructed in a free state, the flanges 11 and 11a of the annular sealing unit 8, intermediate packing 19 and end packing 20 are, respectively, established so as to be resiliently deformable under compression.

[0031] Also, as still another embodiment of the covering members 7 and 7a, a columnar projecting portion (not illustrated) idly inserted into the openings at both ends of the casing 4 is formed at one end side of the plate-like covering members 7 and 7a, and where such covering members 7 and 7a are mounted, the flange 11 and 11a of the annular sealing unit 8 in the mixing assembly elements 5 are pressed in the casing 4, wherein the dimension L2 may be changed in design by the projection dimension of the columnar projection portion.

[0032] Further, the positional slip of the two large and small disks 14 and 15 in the circumferential direction in the mixing assembly elements 9 is regulated by the projection portion 26 formed where a pin 24 and a pin inserting hole 25 are formed.

[0033] Next, the structural actions of the static fluid mixer are to firmly maintain the contacting state of the upper end faces of the side wall 12 which forms small chambers 13, 13a, etc., at the disks 14 and 15 since the covering members 7 and 7a are mounted at both ends and the mixing assembly elements 5 are placed and nipped therebetween, and at the same time to provide a sealing function at the outer circumferential side since the flanges 11 and 11a of the annular sealing unit 8 are brought into close contact with the outer circumferential side of the rear side of the large diameter disk 14 in a resiliently compressible and deformable state, whereby leakage from the rear side of the large diameter disk 14 into the annular sealing unit 8 and leakage from the contacting portion of the flanges 11 and 11a into between the outer circumferential side of the annular sealing unit 8 and the inner circumferential face of the casing 4 can be regulated.

[0034] Further, in an embodiment in which the intermediate packing 19 and end packing 20 are provided as the packing members 18 consisting of only a disk body 21, the intermediate packing 19 and end packing 20 are, respectively, resiliently compressibly and deformably placed in space ranging from the surrounding of the circulating pore 16 at the rear side of the large diameter disk 14 to the portion sealed by the flanges 11 and 11a of the annular sealing unit 8, wherein the intermediate packing 19 and end packing 20 are brought into close contact with the rear side of the large diameter disk 14 at such a portion to provide a sealing function, whereby leakage from the rear side of the large diameter disk 14 into the annular sealing unit 18 and leakage from the contacting portion of the flanges 11 and 11a into space between the outer circumferential face of the annular sealing unit 8 and the inner circumferential face of the casing 4 can be regulated, and the sealing function can be further improved.

[0035] Further, in the embodiment in which the intermediate packing 19 and end packing 20 are mounted as a packing member 18 which forms the columnar portions 22 and 22a of the disk body 21, there may be a case where a slight space or clearance is formed between the outer circumferential face of the disk body 21 and the inner circumferential face of the flanges 11 and 11a of the annular sealing unit 8. Therefore, although there is a slight possibility for fluid to leak out of such space or clearance, with the preferred embodiment, a feature to regulate the leakage through such a space or clearance can be further improved than in the above case.

[0036] Next, a description is given of the mixing actions of a static fluid mixer according to the invention.

[0037] As a basic mixing action, as a fluid is compressed and is caused to flow from the inlet 2 of the static fluid mixer into the internal space of the casing 4, a flow of fluid reaches, as show in, for example, by the arrows in FIG. 1, the interior through the circulating pore 16 of the upstream side mixing assembly elements 9, and flows and circulates in a complicated state with right angle collisions, dispersions, confluence, serpentine flows, and vortex flows combined, uniformly radially from the middle portion to the outside through a plurality of small chambers communicated with each other.

[0038] As described above, the fluid reaching the inner circumferential face of the annular sealing unit 8, passing through the upstream side mixing assembly elements 9, enters respective small chambers 13, 13a, etc., of the downstream side mixing assembly elements 9 formed by the inner circumferential face of the annular sealing unit 8 and the small diameter disk 15, wherein the fluid is collected at the middle portion through complicated flows such as right angle collisions, dispersions, confluence, serpentine flows, vortex flows, etc., as described above, and circulates in the mixing assembly elements 9 one after another in a complicated state such as right angle collisions, dispersions, confluence, serpentine flows, vortex flows, etc., from the middle portion to the outside, again passing through other small chambers 13, 13a, etc. Finally, the fluid is discharged through the outlet 3.

[0039] Further, a fluid can be uniformly dispersed and mixed by right angle collisions against the bottoms of the respective small chambers 13, 13a, etc., and side walls, dispersions from the respective small chambers 13, 13a, etc., to the other plurality of small chambers 13, 13a, etc., confluence or serpentine flows from a plurality of small chambers 13, 13a, etc. to one of the other small chambers 13, 13a, etc., hydrodynamic shearing by vortex flows from a plurality of small chambers 13, 13a, etc., to the respective small chambers 13, 13a, etc., hydrodynamic shearing, impact breakage when passing through orifices being communicating paths from the respective small chambers 13, 13a, etc., to the other small chambers 13, 13a, etc., and shearing, mechanical cavitation, etc., when passing through the upper end face of the side walls 12, etc.,

Industrial applicability

[0040] In summary, in the present invention, covering members 7 and 7a having an inlet 2 and an outlet 3 formed at both ends of a cylindrical casing 4 are detachably formed. A cylindrical body 10 is formed of a resilient body with an outer diameter that can be idly inserted into the casing 4. An annular sealing unit 8 is formed by integrally forming flanges 11 and 11a inward of both ends of the cylindrical body 10. Two large and small disks 14 and 15, in which a number of small chambers 13, 13a, etc., having an open end at the front ends thereof opposed each other are arrayed, are prepared as a set and are caused to overlap each other to establish a mixing element 9. The outer diameter of the large diameter disk 14 is formed at a larger outer diameter than the inner circumferential diameter of the flanges 11 and 11a of the annular sealing unit 8, and a circulating pore 16 is prepared at the middle. At the same time, the outer diameter side of the small diameter disk 15 is constructed so as to form a circulating path 17 between the outer circumferential side thereof and the inner circumferential side of the cylindrical body 10. Small chambers 13, 13a, etc., of the large diameter disk 14 of such a mixing element 9 and small chambers 13, 13a, etc., of the small diameter disk 15 are caused to communicate with the other plurality of small chambers 13, 13a, etc., to which the respective small chambers 13, 13a, etc., are opposite, and at the same time, are arrayed with the positions thereof changed so that the crossing connection portions of the side walls 12 which form the other small chambers at the centers of the small chambers 13, 13a, etc. The large diameter disk 14 is disposed at both sides in the abovementioned annular sealing unit 8, wherein two small diameter disks 15 are arrayed therebetween to constitute a mixing assembly element 5, and the mixing assembly elements 5 are arrayed in the casing 4 and are placed and nipped between the covering members 11 and 11a at both ends of the casing 4 so that the flanges 11 and 11a of the annular sealing unit 8 are resiliently deformed under compression. Therefore, the mixing elements 9 can be internally placed in the casing 4 in the form of a mixing assembly element 5 internally incorporated in the annular sealing unit 8, and simultaneously since the large diameter disk 14 is disposed at both sides of the mixing assembly element 5 when internally incorporating it in the casing 4, it can be internally mounted in the casing 4 regardless of the flow direction. Accordingly, the assembly can be remarkably facilitated.

[0041] Since it is not necessary to provide a sealing function between the outer circumferential surface of the annular sealing unit 8 and the inner circumference of the casing 4, the machining accuracy of the inner circumferential surface may be roughened. The machining of a casing 4 in which a number of mixing assembly elements 5 are provided becomes further easy, whereby production costs may be reduced. Moreover, since the outer diameter of the large diameter disk 14 of the mixing element 9 is brought into close contact with the inner face of the flanges 11 and 11a of the annular sealing unit 8, it is possible to prevent play in the diametrical direction when mixing a fluid. Further, since the annular sealing unit is made of a resilient material, the annular sealing unit 8 can function as a shock absorber against vibrations in cases where the mixing elements 9 vibrate due to pulsation occurring when a fluid passes through the mixing elements 9 while flowing in a complicated state and pulsation of a pump itself, whereby the annular sealing unit 8 can absorb or deteriorate vibrations of the mixing elements 9. Therefore, it is possible to prevent adverse influences upon the surrounding devices and the structural body. Also, since the covering members 7 and 7a are mounted at both ends of the casing 4 and the mixing assembly elements 5 are placed and nipped therebetween, it is possible to firmly maintain the contacting state of the upper end surface of the side walls 12 which form the small chambers 13, 13a, etc., at the disks 14 and 15, and play of the respective disks 14 and 15 can be prevented. Still further, insufficiency in mixing due to short-circuited flows, which may occur due to leakage through the upper end face of the side walls 12 or the outer circumferential side of the large diameter disk 14 can be further improved.

[0042] In addition, since a packing member 18 having a communicating pore 23 formed at the middle thereof is caused to intervene in space inward of the flanges 11 and 11a of the annular sealing unit 8 at the mixing assembly element 5 arrayed in a plurality in the casing 4 in a state where the packing member 18 is resiliently made compressible and deformable when mounting the covering members 7 and 7a, the packing member 18 is brought into close contact with the rear side of the large diameter disk 14 at such a portion, and a sealing function is provided on the entire rear side from the surrounding of the circulating pore 16 of the large diameter to the inner circumferential edge of the flanges 11 and 11a of the annular sealing unit 8, whereby leakage of a fluid from the rear side of the large diameter disk 14 into the annular sealing unit 8 or leakage from the contacting portion of the flanges 11 and 11a into space between the outer circumferential surface of the annular sealing body 8 and the inner circumferential surface of the casing 4 can be further better regulated. That is, the sealing function can be further improved. Therefore, insufficiency in mixing due to short-circuited flows resulting from such leakage can be further improved.

[0043] Also, since a packing member 18 having a communicating pore 23 formed at the middle thereof is caused to intervene in space inward of the flanges 11 and 11a of the annular sealing unit 8 at the mixing assembly element 5 arrayed in a plurality in the casing 4 or between the flanges 11 and 11a of the annular sealing unit 8 in a state where the packing member 18 is resiliently made compressible and deformable when mounting the covering members 7 and 7a, slight space or clearance is formed between the outer circumferential surface of the disk body 21 and the inner circumferential surface of the flanges 11 and 11a of the annular sealing unit 8 in the case of a packing member 18 consisting of only a disk body 21 as described above, there is a slight possibility for a fluid to leak from such a portion. However, according to the invention, the leakage of a fluid from such a portion can be still further prevented, whereby the practical application effect becomes remarkable.

Claims

1. A static fluid mixer, wherein covering members having an inlet and an outlet formed at both ends of a cylindrical casing are detachably formed; a cylindrical body is formed of a resilient body with an outer diameter that can be idly inserted into a casing; an annular sealing unit is formed by integrally forming flanges inward of both ends of said cylindrical body; two large and small disks, in which a number of small chambers having an open end at the front ends thereof opposed each other are arrayed, are prepared as a set and are caused to overlap each other to establish a mixing element; the outer diameter of the large diameter disk is formed at a larger outer diameter than the inner circumferential diameter of the flanges of the annular sealing unit; a circulating pore is provided at the middle; the outer diameter side of the small diameter disk is constructed so as to form a circulating path between the outer circumferential side thereof and the inner circumferential side of the cylindrical body 10; small chambers of the large diameter disk of such a mixing element and small chambers of the small diameter disk are caused to communicate with the other plurality of small chambers, to which the respective small chambers are opposite, and are simultaneously arrayed with the positions thereof changed so that the crossing connection portions of the side walls which form the other small chambers at the centers of the small chambers; the large diameter disk is disposed at both sides in said annular sealing unit; and two small diameter disks are arrayed therebetween to constitute a mixing assembly element, and said mixing assembly elements are arrayed in the casing and are placed and nipped between the covering members at both ends of the casing so that the flanges of the annular sealing unit are resiliently deformed under compression.

2. A static fluid mixer as set forth in Claim 1, wherein a packing member having a communicating pore formed at the middle thereof is caused to intervene in a space inward of the flanges of an annular sealing unit in a mixing assembly element arrayed in a plurality in the casing in a state where said packing member is resiliently compressible and deformable.

3. A state fluid mixer as set forth in Claim 1, wherein a packing member having a communicating pore formed at the middle thereof is caused to intervene in a space inward of the flanges of an annular sealing unit in a mixing assembly element arrayed in a plurality in the casing or between flanges of an annular sealing unit, in a state where said packing member is resiliently compressible and deformable.

Fig. 1

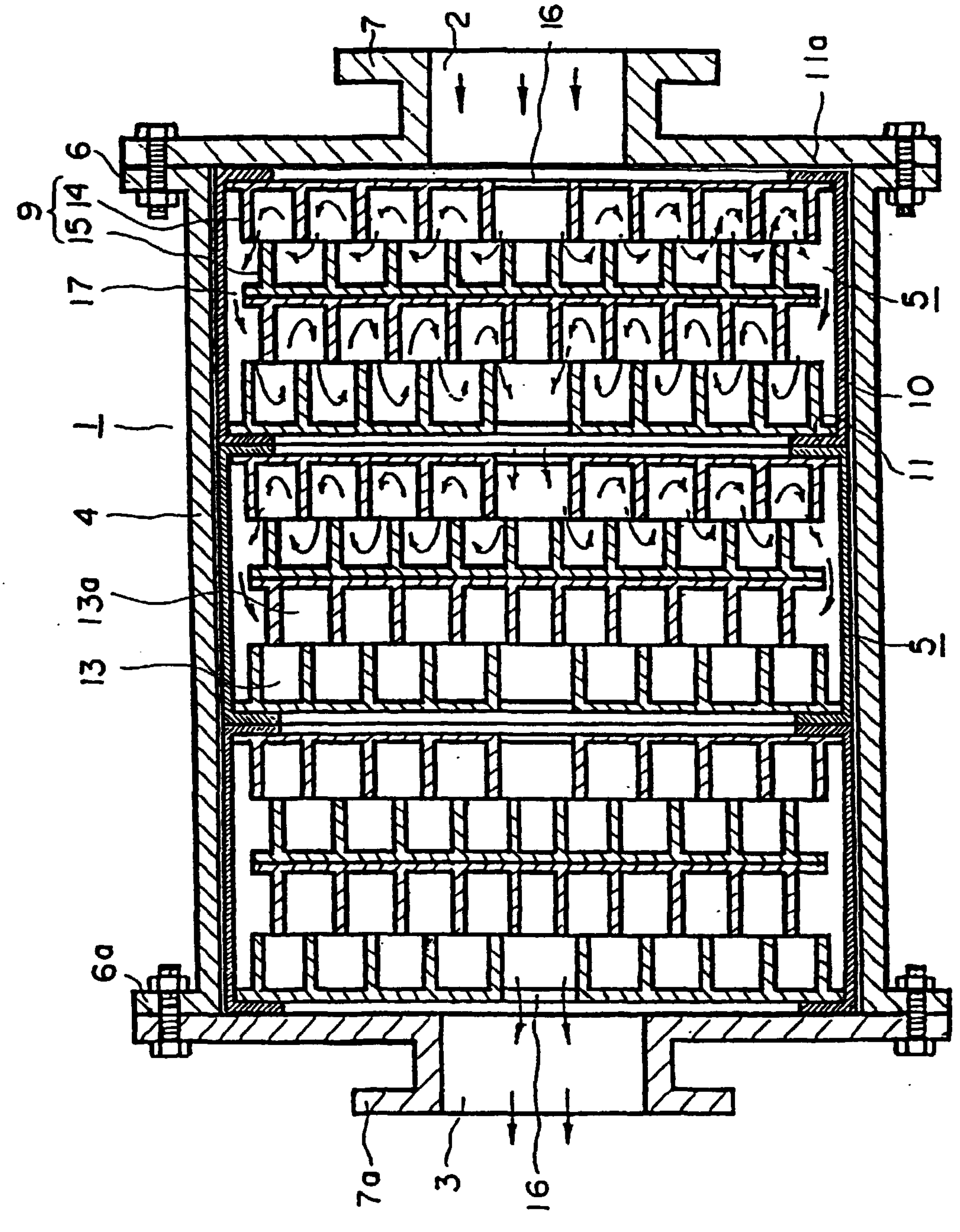


Fig. 2

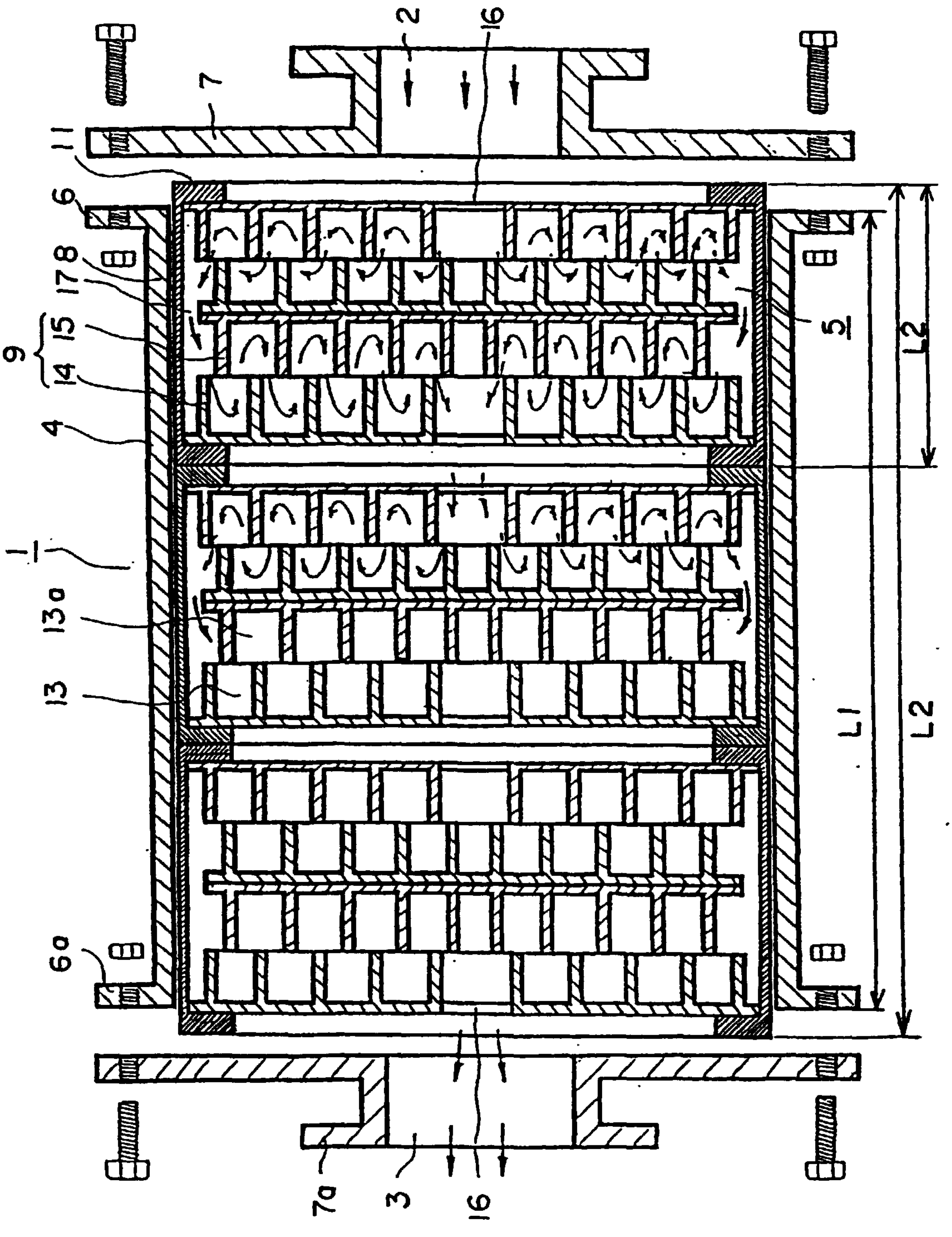


Fig. 3

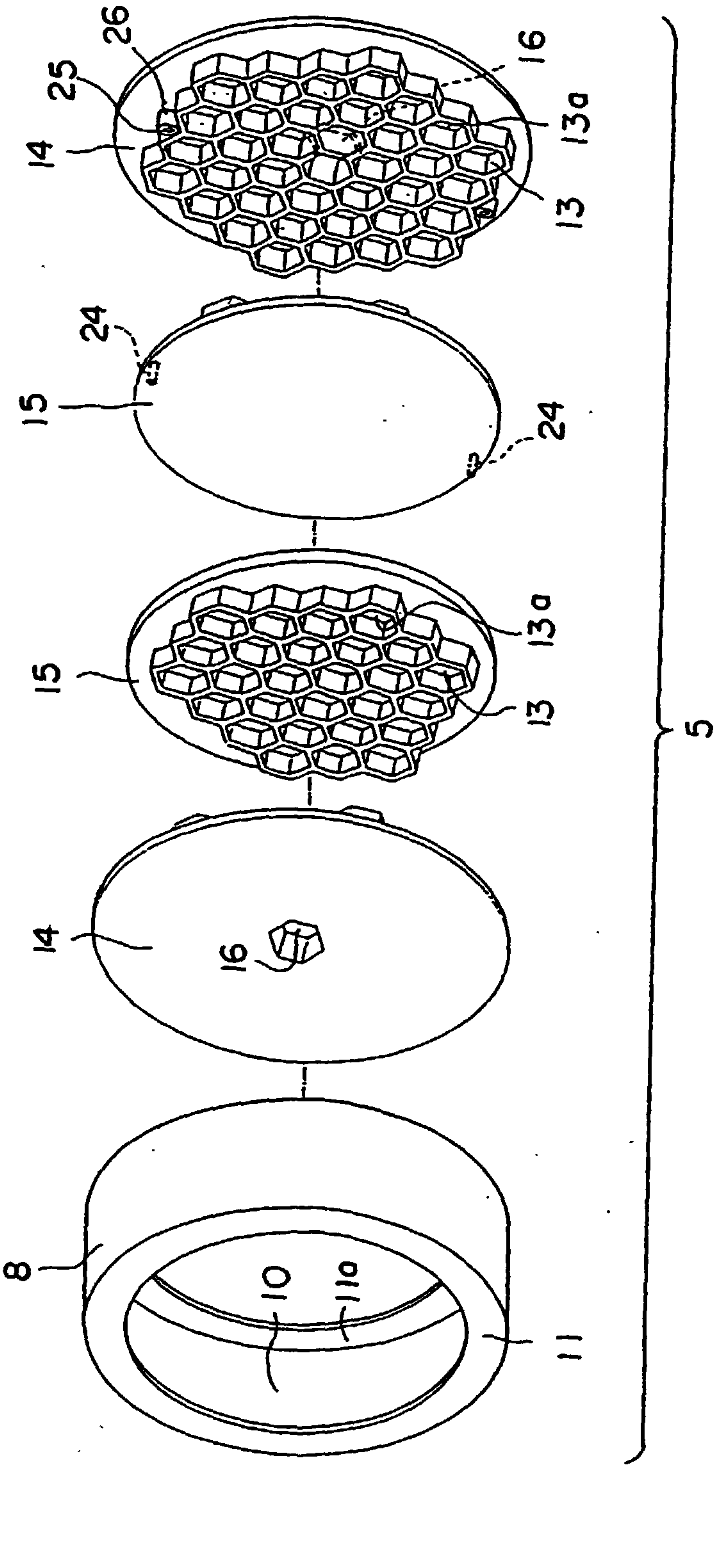


Fig. 4

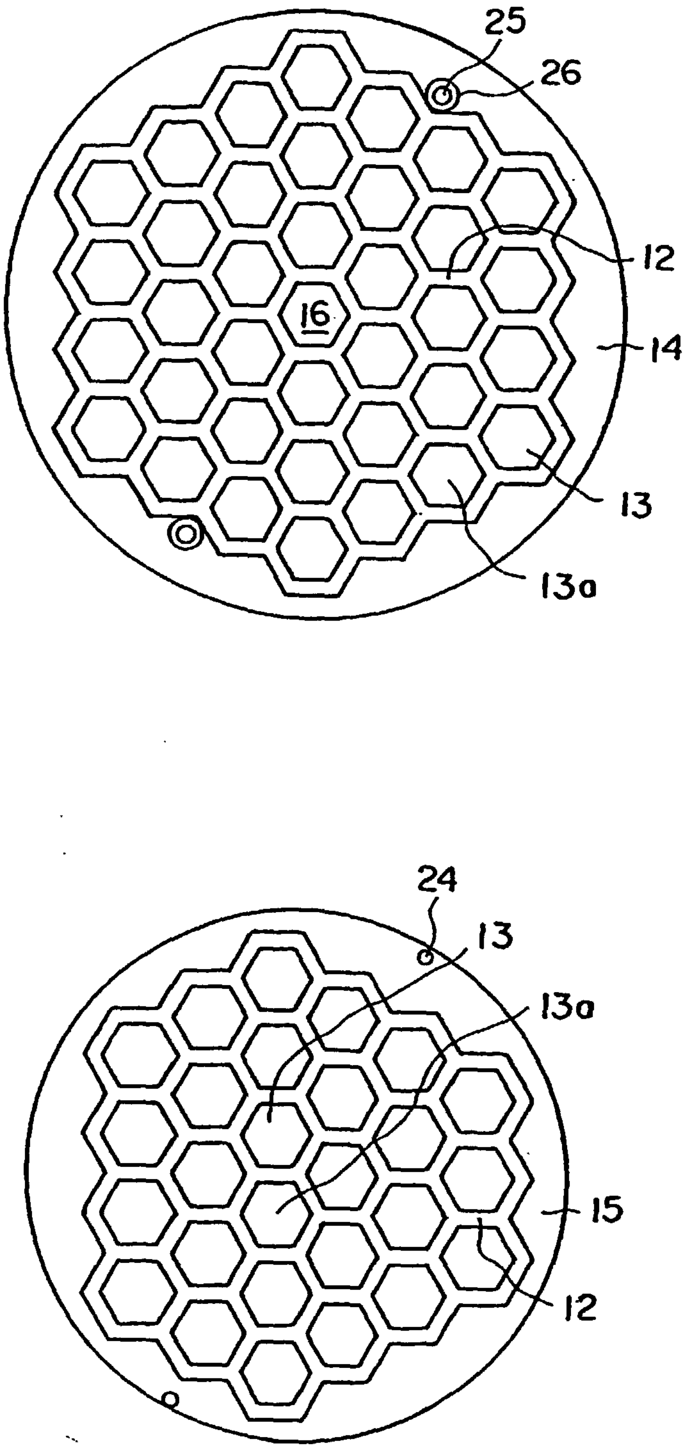
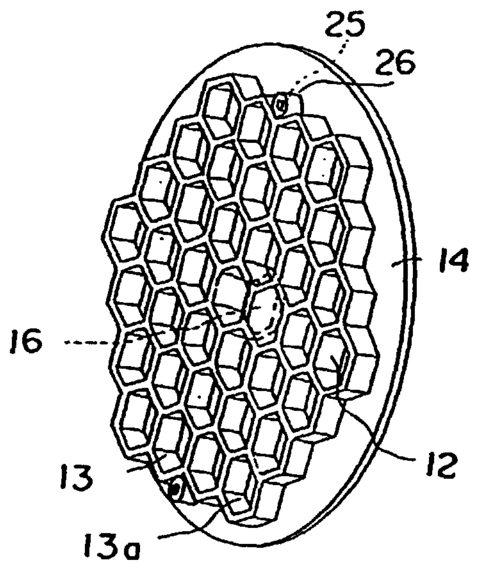


Fig. 5



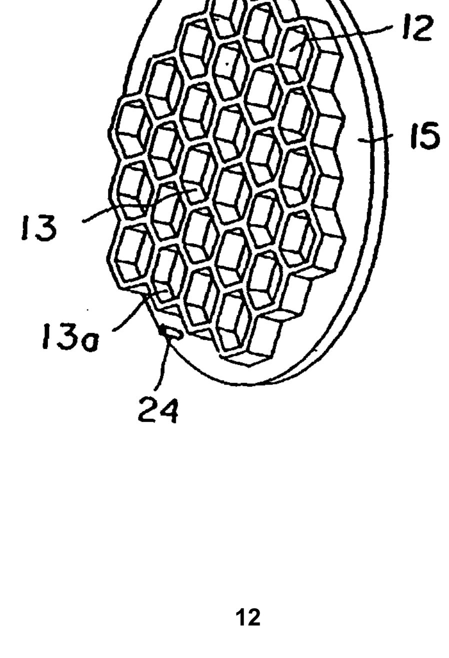


Fig. 6

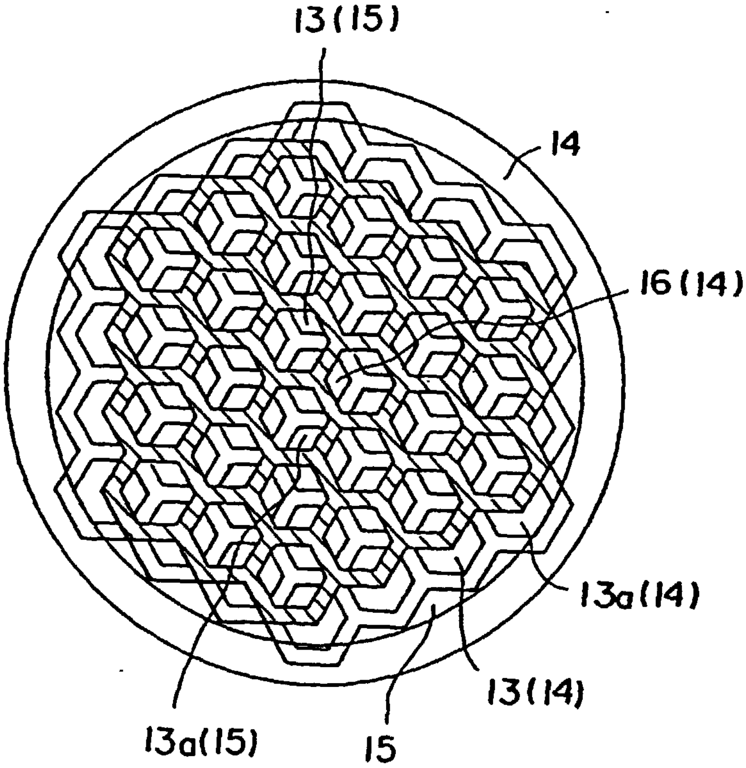


Fig. 7

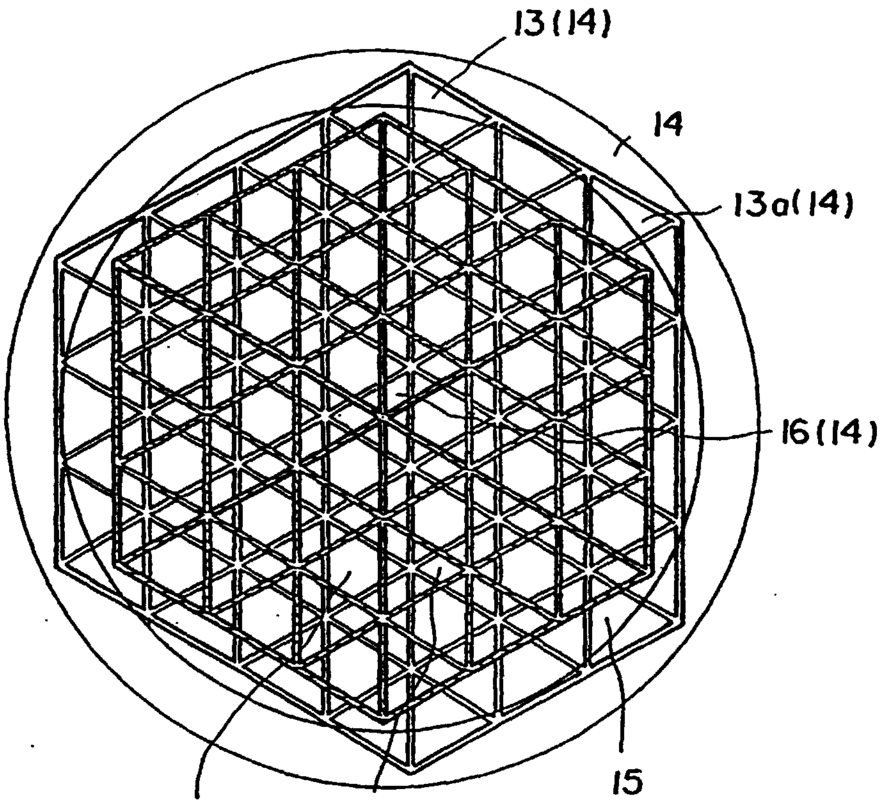


Fig. 8

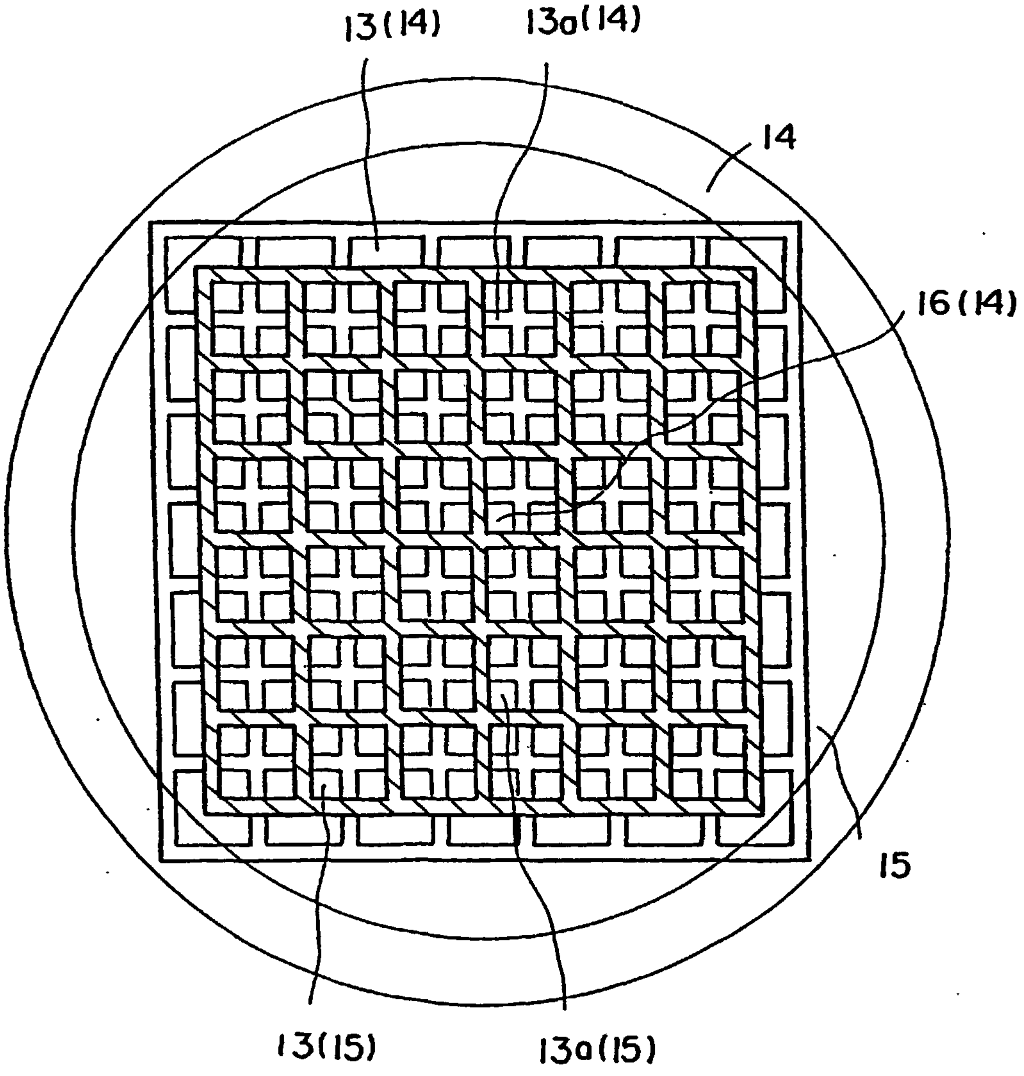


Fig. 9

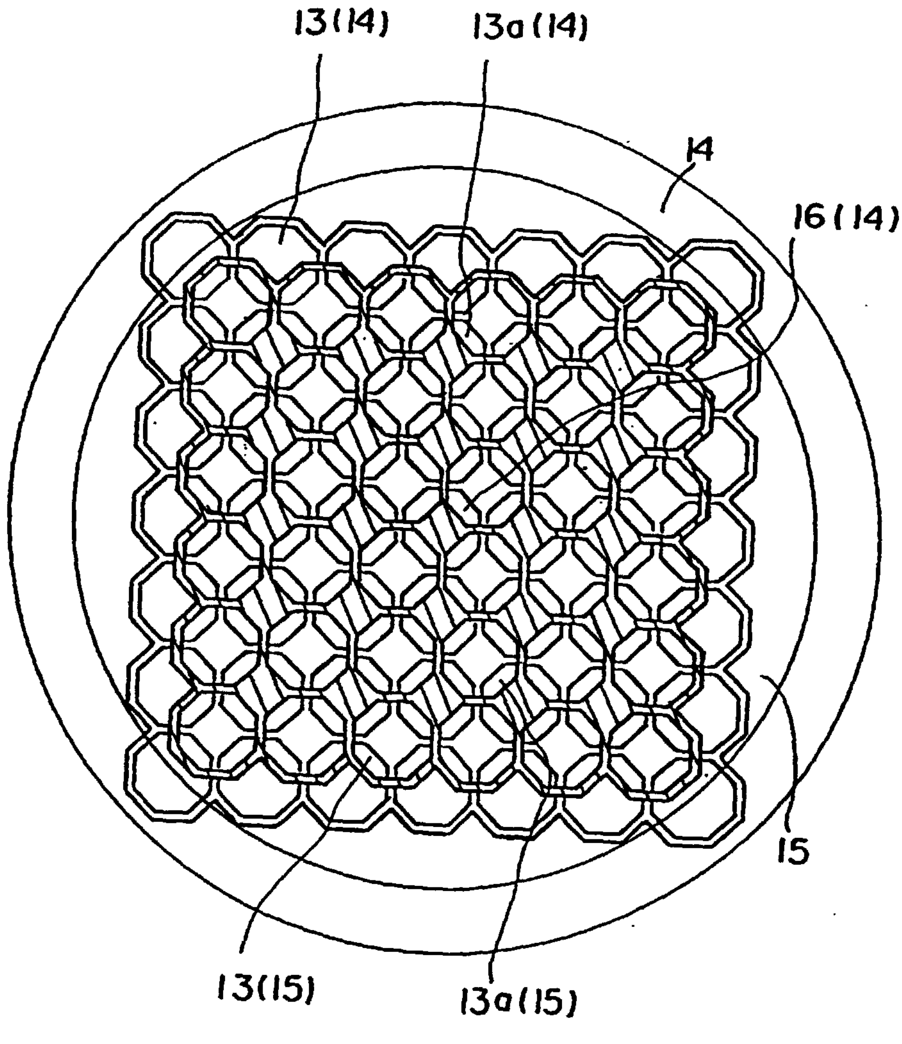


Fig. 10

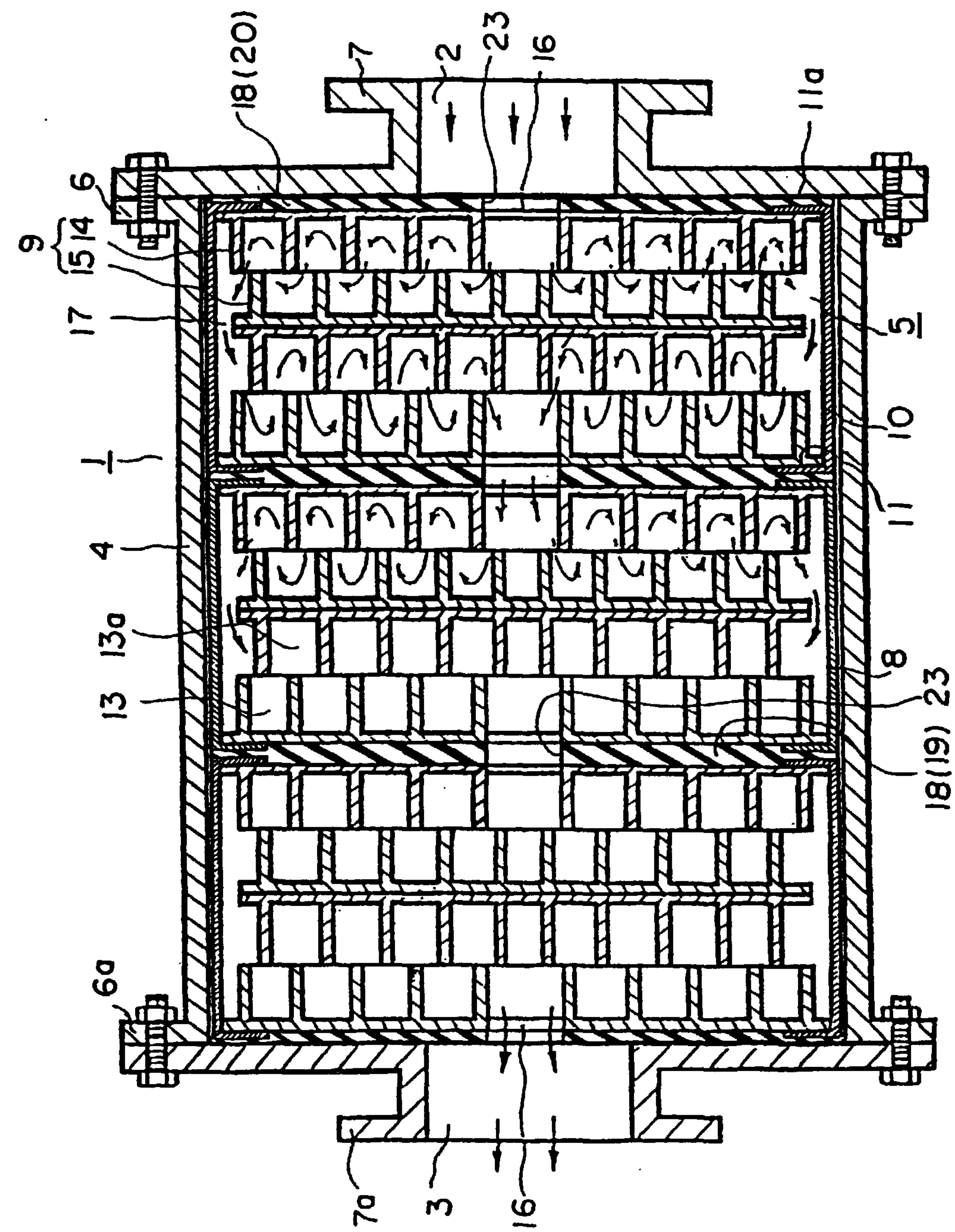
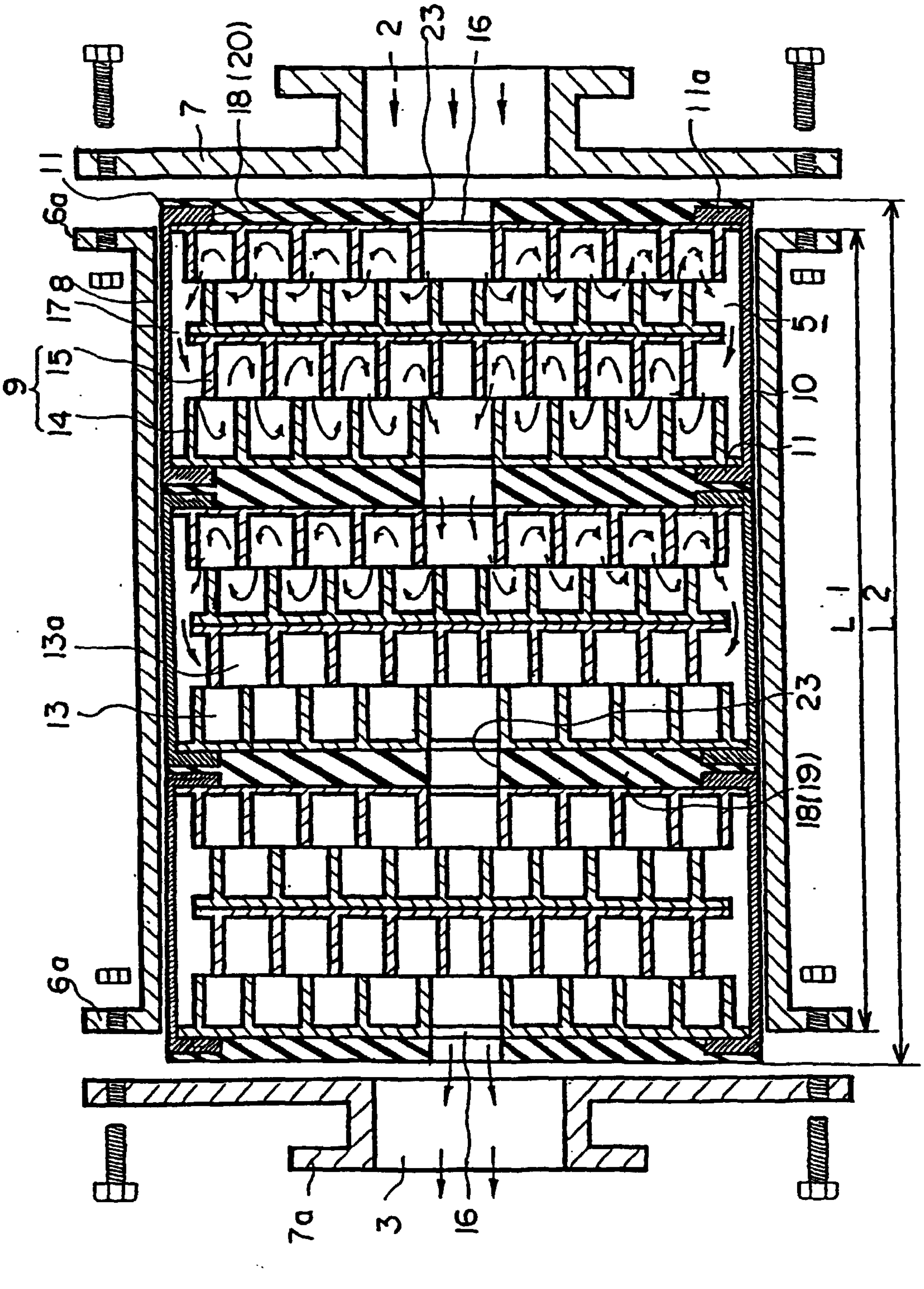


Fig. 11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L1
L2
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18(19)
6a
7a
3
16

Fig. 12

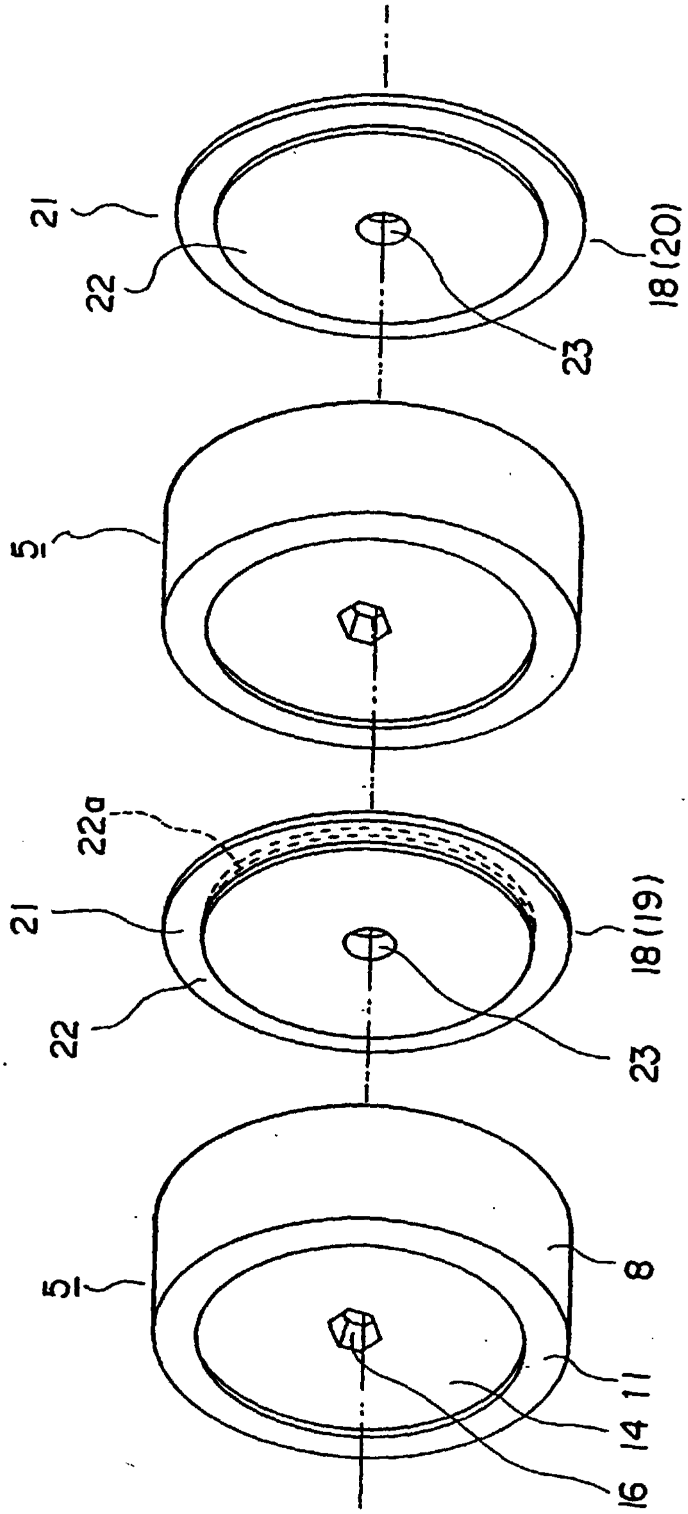


Fig. 13

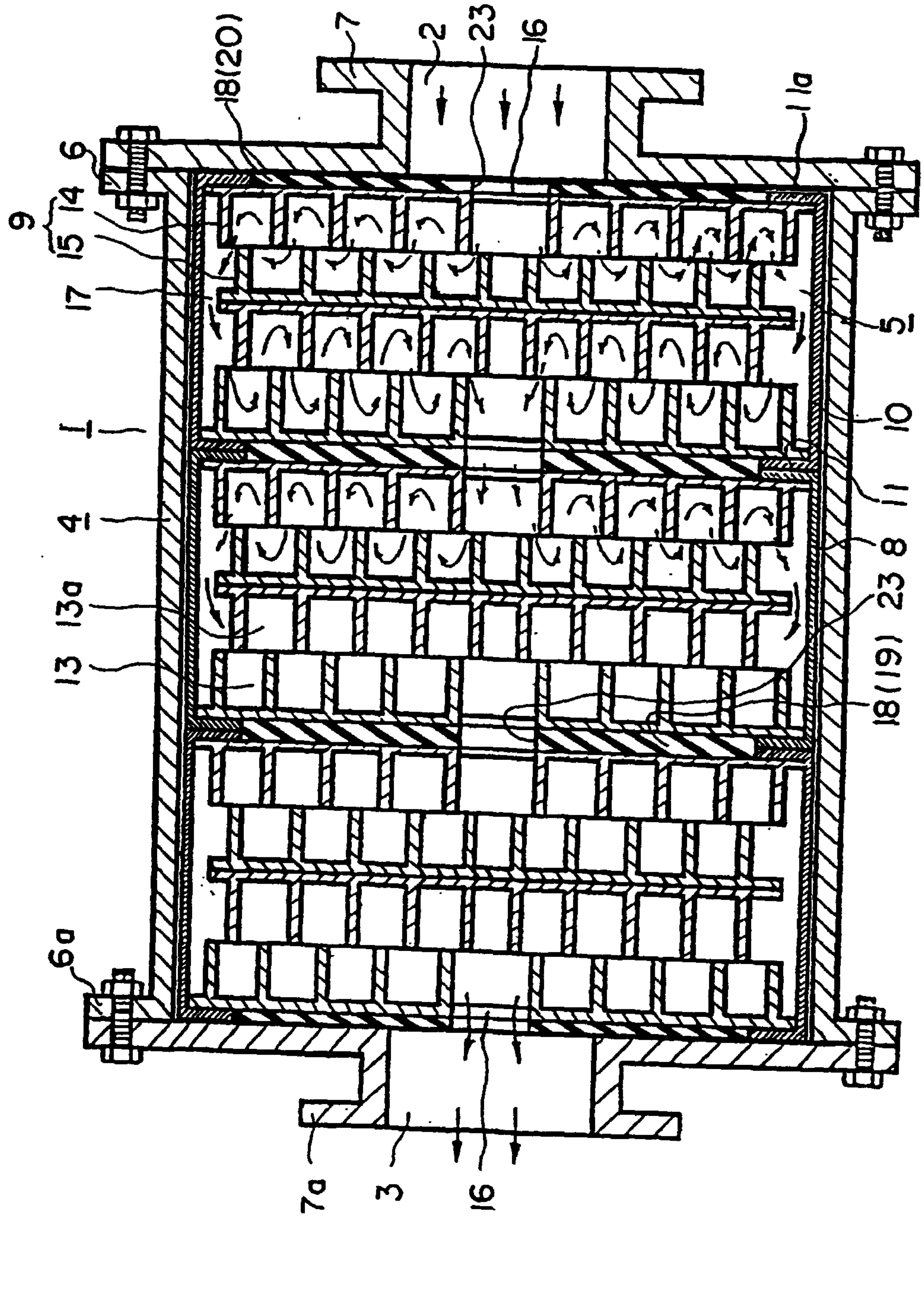


Fig. 14

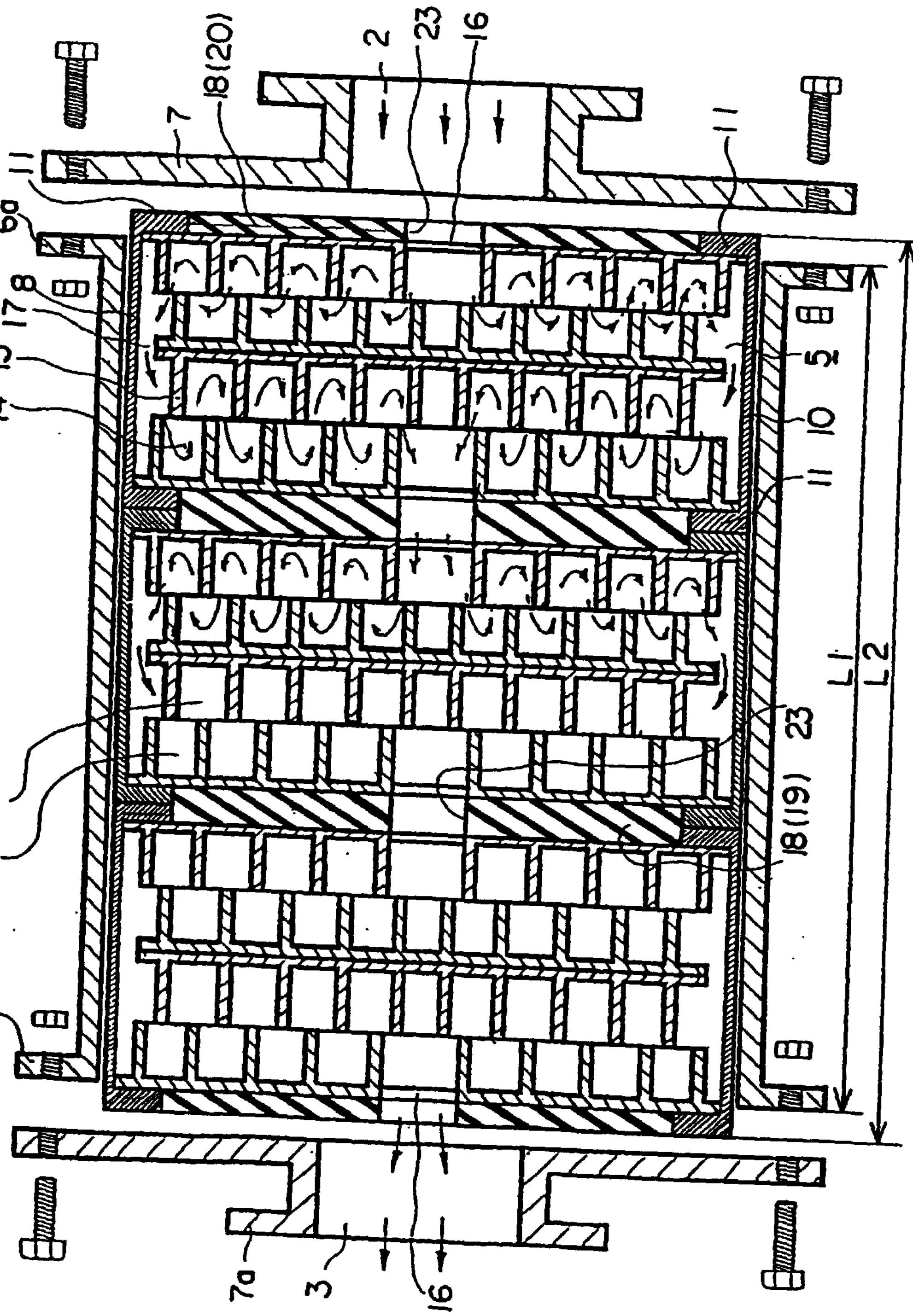
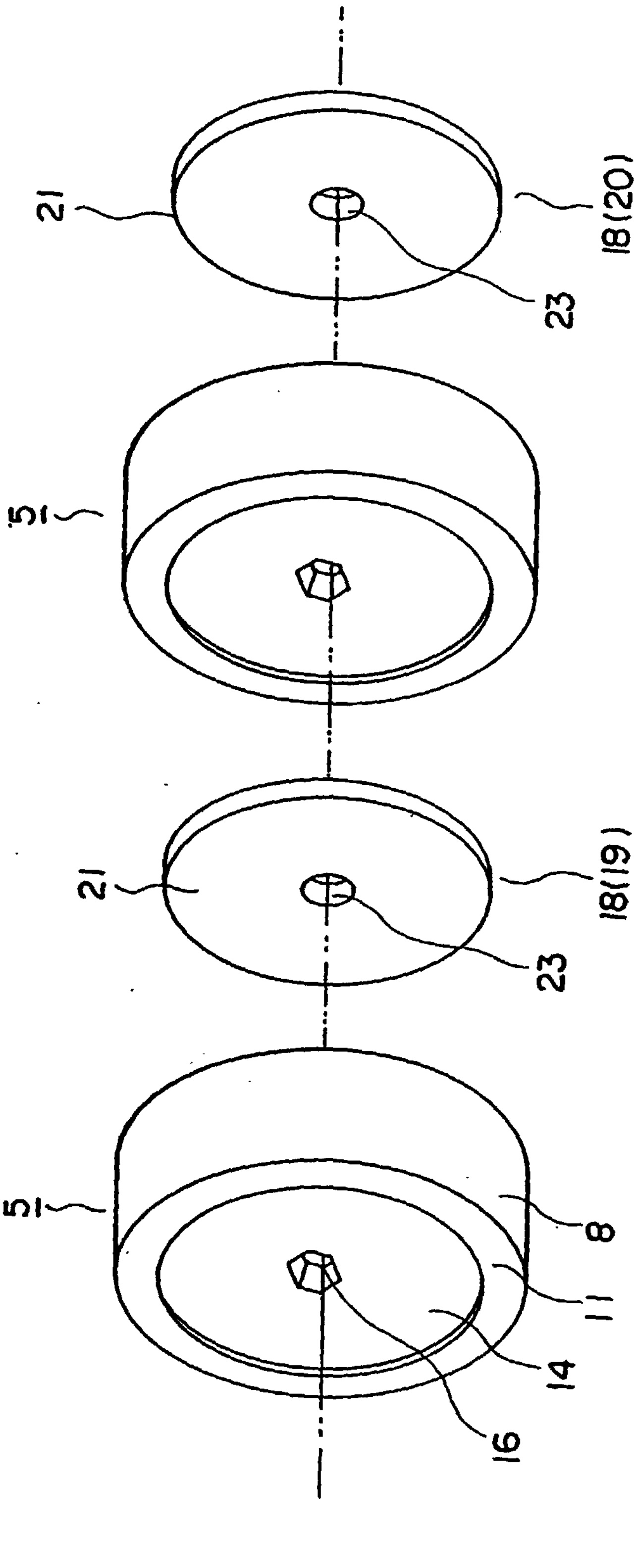


Fig. 15



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP97/02174

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl[6] B01F5/00

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)

Int. Cl[6] B01F3/00-5/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1996
Kokai Jitsuyo Shinan Koho 1971 - 1997
Toroku Jitsuyo Shinan Koho 1994 - 1997
Jitsuyo Shinan Keisai Koho 1996 - 1997

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
EX	JP, 9-173807, A (Kankyo Kagaku Kogyo K.K.), July 8, 1997 (08. 07. 97), Claims 1 to 3; column 3, lines 33 to 42; Figs. 11 to 14 (Family: none)	1 - 3
A	JP, 9-52034, A (Kankyo Kagaku Kogyo K.K.), February 25, 1997 (25. 02. 97)(Family: none)	1 - 3
A	JP, 58-133824, A (Meiyu Sangyo K.K.), August 9, 1983 (09. 08. 83)(Family: none)	1 - 3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
September 10, 1997 (10. 09. 97)	September 24, 1997 (24. 09. 97)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)