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

(11) EP 1 262 646 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.12.2002 Bulletin 2002/49

(51) Int Cl.[7]: **F02D 9/10**

(21) Application number: **02010676.1**

(22) Date of filing: **13.05.2002**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **31.05.2001 JP 2001164870**

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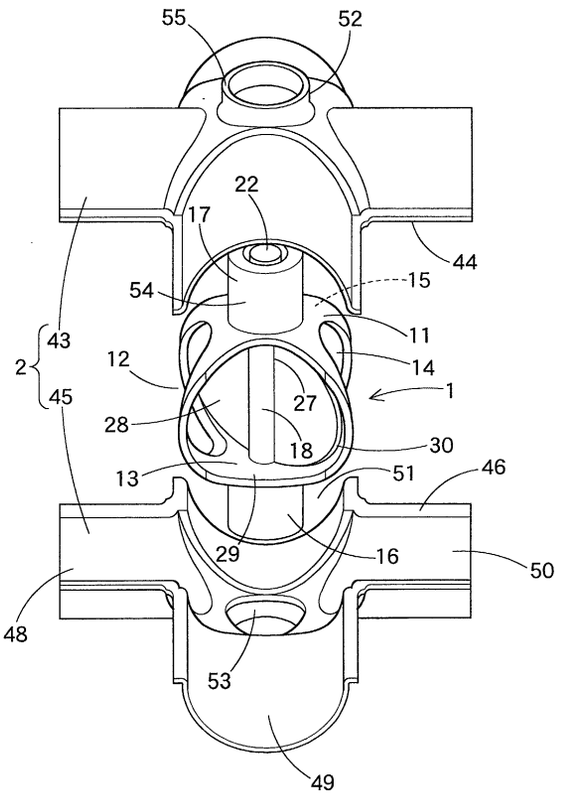
(54) Valve apparatus

(57) A valve apparatus comprising a case (11) for accommodating a valve (28) and a body (2) forming a fluid passage as separate constituent elements, and the case (11) is fixed and disposed in the body (2).

Fig.1



EP 1 262 646 A2

Description

2. Background of the Invention

(1) Field of the Invention

[0001] The present invention relates to a valve apparatus, and more particularly, to a valve apparatus capable of being applied to a control valve of an air intake system and an air exhaust system of an internal combustion engine.

2) Description of the Prior Art

[0002] According to a conventional valve apparatus, a body 100 is formed of thick casting as shown in Figs. 10 and 11 for example, or the body 100 is formed of thin pipe as shown in Fig.12. In Figs.10, 11 and 12, a reference number 200 represents a valve, and a reference number 300 represents a shaft.

[0003] However, in the case of the casting body, there is a problem that its weight is heavy. In the case of the pipe body, since the body is thin, there is a problem that it is difficult to secure the rigidity. Further, when a pipe, e.g., an end of an exhaust pipe of an internal combustion engine is welded to an end of the body, there is a problem that a distortion is generated in the body due to the welding heat, and the hermeticity is prone to be deteriorated. Further, the conventional valve apparatus is produced for each kind, and commonality of components can not be achieved.

3. Summary of the Invention

[0004] It is an object of the present invention to provide a new valve apparatus which solves the problems of the conventional valve apparatus, reduces its weight, secures the rigidity and hermeticity, and achieves the commonality of components.

[0005] A valve apparatus of the present invention comprises a case for accommodating a valve and a body forming a fluid passage as separate constituent elements, and the case is fixed and disposed in the body.

[0006] The case comprises a compact such as casting, and the body is made of metal or thin compact.

[0007] The case has four ports.

[0008] The body forms fluid passages which are in communication with four ports of the case.

[0009] The body forms fluid passages which are in communication with three ports among the four ports of the case, and the remaining port is occluded.

[0010] The valve is a butterfly valve, and an abutment position between an outer peripheral edge of the butterfly valve and the butterfly valve of the case has a sealing structure.

4. Brief Description of the Drawings

[0011]

Fig.1 is an exploded perspective view of a valve apparatus according to a first embodiment of the present invention;
Fig.2 is a perspective view after the valve apparatus was assembled;
Fig.3 is a sectional view showing a structure of a shaft and its bearing;
Fig.4 is a perspective view of a valve section in which a portion of a case is partially cut away;
Fig.5 is a sectional view showing a sealing structure;
Fig.6 is a sectional view showing a modification of the sealing structure;
Fig.7 is a sectional view showing another modification of the sealing structure;
Fig.8 is an exploded perspective view of a valve apparatus according to a second embodiment of the present invention;
Fig.9 is a perspective view after the valve apparatus was assembled;
Fig.10 is a sectional view of a conventional valve apparatus;
Fig.11 is a sectional view of another conventional valve apparatus; and
Fig.12 is a sectional view of further another conventional valve apparatus.

5. Description of the Preferred Embodiments

[0012] In Figs.1 to 9, a vertical direction in Figs.1 to 3 and Figs.8 and 9 does not always coincide with a perpendicular direction, but the following explanation is based on the vertical direction in the drawings.

[0013] In Figs.1 to 5, a valve apparatus according to the first embodiment includes a valve assembly 1 and a body 2.

[0014] The valve assembly 1 has a case 11 as a constituent element.

[0015] The case 11 comprises a compact such as casting. The case 11 includes openings 12, 13, 14 and 15 which become longitudinally and laterally extending ports.

[0016] Lower and upper portions of the case 11 respectively include outwardly projecting cylindrical bearing accommodating sections 16 and 17. The lower bearing accommodating section 16 accommodates therein a bearing 20 which rotatably supports a lower end 19 of a shaft 18. An opening of the bearing accommodating section 16 is tightly closed by a sealing plug 21 or by forming a tip end of a cylindrical section 53 of the body 2 into a dead end shape. The upper bearing accommodating section 17 accommodates therein a bearing 23 which rotatably holds an upper end 22 of the shaft 18. An opening of the bearing accommodating section 17

passes through an upper end 22 of the shaft 18, and a gap between an inner peripheral surface 24 of the opening and an outer peripheral surface 25 of the upper end 22 of the shaft is tightly closed by a sealing plug 26.

[0017] The shaft 18 includes a long hole 27 extending in the vertical direction. A substantially disc-like valve 28 is inserted into the long hole 27, and is fixed to the shaft 18 using sealing structure (not shown) such as a mounting bracket.

[0018] The valve 28 is a butterfly valve. The valve 28 assumes two rotation positions. Depending upon the rotation positions, one of a first mode which brings the ports 12 and 13 into communication with each other and brings the ports 14 and 15 into communication with each other, and a second mode which brings the ports 12 and 15 into communication with each other and brings the ports 13 and 14 into communication with each other is selected. As shown in Figs.4 and 5, an inner peripheral surface 29 of the case 11 includes steps 31, 32, 33 and 34 to which an outer peripheral edge 30 of the valve 28 abuts. One surfaces 35, 36, 37 and 38 of the outer peripheral edge 30 come into surface contact with the step surface 31, 32, 33 and 34, and which secures sealing, i.e., hermeticity.

[0019] As another example of such a sealing structure as shown in Fig.6, it is possible to propose a structure in which a cross section of the outer peripheral edge 30 of the valve 28 is formed into a convex triangular shape, inclined surfaces 39, 40, 41 and 42 of the outer peripheral edge 30 come into surface contact with the flat inner peripheral surface 29 of the case 11.

[0020] Further, as shown in Fig.7, it is possible to propose a structure in which the cross section of the outer peripheral edge 30 of the valve 28 is formed into an arc shape, and the outer peripheral edge 30 comes into line contact with the flat inner peripheral surface 29 of the case 11.

[0021] The body 2 has a cross shape in the vicinity of the case 11 as viewed from above. The body 2 is of an upper and lower two body structure comprising a mating surface 44 of an upper half body 43 and a mating surface 46 of a lower half body 45, and the mating surface 44 and the mating surface 46 are superposed and welded to each other, thereby integrally forming the body 2. Each of the upper half body 43 and lower half body 45 is made of thin metal. The case 11 is fixed to and disposed in a central portion 47 of the body 2. The body 2 includes four fluid passages 48, 49, 50 and 51 extending in the longitudinal direction and lateral direction from the central portion 47. The fluid passages 48, 49, 50 and 51 are respectively in communication with the corresponding ports 12, 13, 14 and 15 of the case 11. The upper and lower ends of the central portion 47 of the body 2 respectively include cylindrical sections 52 and 53. The upper bearing accommodating section 17 upwardly projects from the upper cylindrical section 52, and a gap between the outer peripheral surface 54 of the bearing accommodating section 17 and the upper end surface 55 of the cylindrical section 52 is occluded by welding. The lower bearing accommodating section 16 downwardly projects from the lower cylindrical section 53, and a gap between the outer peripheral surface 56 of the bearing accommodating section 16 and the lower end surface of the cylindrical section 53 is occluded by welding. The upper end 22 of the shaft 18 is connected to a lever 58 which is rotated and operated by a driving mechanism (not shown). The fluid passage of the body 2 may be curved.

[0022] When the valve 28 is in the rotation position as shown in Fig.2, the valve apparatus having the above-described structure maintains the communication state between the ports 12 and 13, and between the ports 14 and 15, and maintains the non-communication state between the ports 12, 13 and the ports 14, 15. From this state, if the lever 58 is rotated and operated and the valve 28 assumes the other rotation position, the ports 12 and 15, as well as the ports 13 and 14 are brought into communication with each other, and the ports 12, 15 and the ports 13, 14 are brought into non-communication state. Thereafter, if the lever 58 is rotated and operated in the opposite direction from the former rotating and operating direction, the valve 28 is again returned to the rotation position as shown in Fig.2.

[0023] In Figs.8 and 9, a valve apparatus according to a second embodiment includes the valve assembly 1 and the body 2.

[0024] The valve assembly 1 has a case 11 as a constituent element.

[0025] The case 11 comprises a compact such as casting. The case is formed into a substantially cylindrical shape, and has openings 12, 13, 14 and 15 which become ports in the longitudinal and lateral directions. On an outer peripheral surface 61 of the case 11, seal rings 62 and 63 are disposed at positions corresponding to the ports 13 and 15, respectively. When the valve assembly 1 is disposed between an upper half body 43 and a lower half body 45, and half body 43 and the half body 45 are welded to each other, the seal rings 62 and 63 receive the pressing force from the inner peripheral surfaces of the half bodies 43 and 45, and exhibit sealing ability.

[0026] Lower and upper portions of the case 11 respectively include outwardly projecting cylindrical bearing accommodating sections 16 and 17. Interior structures of each of the lower bearing accommodating section 16 and the upper bearing accommodating section 17 are not illustrated in the drawing, but they are constituted in the same manner as the bearing accommodating sections 16 and 17 in the first embodiment.

[0027] Although it is not illustrated in the drawing, the valve 28 is fixed to the shaft 18 by the same manner as that of the valve 28 of the first embodiment.

[0028] The valve 28 is a butterfly valve. The valve 28 assumes two rotation positions. Depending upon the rotation positions, one of a first mode which brings the ports 12 and 13 into communication with each other and

brings the ports 14 and 15 into communication with each other, and a second mode which brings the ports 12 and 15 into communication with each other and brings the ports 13 and 14 into communication with each other is selected.

[0029] Although it is not illustrated in the drawing, the sealing structure between the valve 28 and the case 11 is the same as that in the first embodiment.

[0030] A cross section of the body 2 is formed into substantially T-shape in the vicinity of the case 11 as viewed from above. The body 2 is of an upper and lower two body structure comprising a mating surface 44 of an upper half body 43 and a mating surface 46 of a lower half body 45, and the mating surface 44 and the mating surface 46 are superposed and welded to each other, thereby integrally forming the body 2. Each of the upper half body 43 and lower half body 45 is made of thin metal or thin compact. The case 11 is fixed to and disposed in a central portion 47 of the body 2. The body 2 includes three fluid passages 48, 49 and 50 extending in three directions from the central portion 47. The fluid passages 48, 49 and 50 are respectively in communication with the corresponding ports 12, 13 and 14 of the case 11. The port 15 is occluded by an occluding wall 64 of the body 2. The upper and lower ends of the central portion 47 of the body 2 respectively include short cylindrical sections 52 and 53. The upper bearing accommodating section 17 upwardly projects from the upper cylindrical section 52, and a gap between the outer peripheral surface 54 of the bearing accommodating section 17 and the upper end surface 55 of the cylindrical section 52 is occluded by welding. The lower bearing accommodating section 16 downwardly projects from the lower cylindrical section 53, and a gap between the outer peripheral surface 56 of the bearing accommodating section 16 and the lower end surface 57 of the cylindrical section 53 is occluded by welding. Although it is not illustrated in the drawing, the upper end 22 of the shaft 18 is connected to a lever 58 (Fig.2) which is rotated and operated by a driving mechanism (not shown) as in the first embodiment. The fluid passage of the body 2 may be curved.

[0031] When the valve 28 is in the rotation position shown in Fig.8, the valve apparatus having the above-described structure maintains the communication state between the ports 12 and 13, and between the ports 14 and 15, and maintains the non-communication state between the ports 12, 13 and the ports 14, 15. However, since the port 15 is always closed, the ports 12 and 13 are maintained in their communicated state, and the ports 12, 13 and 14 are maintained in their non-communicated state. From this state, if the lever 58 is rotated and operated and the valve 28 assumes the other rotation position, the ports 13 and 14 are brought into communication with each other, and the ports 12, 13 and 14 are brought into non-communication state. Thereafter, if the lever 58 is rotated and operated in the opposite direction from the former rotating and operating direction, the valve 28 is again returned to the rotation position shown in Fig.8.

[0032] As explained above, the valve apparatus of the embodiment includes the case 11 for accommodating the valve 28, and the body 2 forming the fluid passage as separate constituent elements, and the case 11 is fixed and disposed in the body 2. Therefore, the case 11 is made of casting and the body 2 is made of metal so that the apparatus is reduced in weight, and the rigidity of the main portion, i.e., of the peripheries of the valve can be secured, and the hermeticity of the valve 28 can be secured.

[0033] Further, since the four ports 12, 13, 14 and 15 are formed in the case 11, the four-way valve can be formed by combining the case 11 and the body 2 having the fluid passages 48, 49, 50 and 51 corresponding to the four ports 12, 13, 14 and 15, and the three-way valve can be formed by combining the case 11 and the body 2 having the fluid passages 48, 49 and 50 corresponding to the three ports 12, 13 and 14. Therefore, the case 11 can be used as a common part.

[0034] Further, since the butterfly valve is used as the valve 28, and the sealing structures 31 to 34 are formed on abutment positions between the outer peripheral edge 30 of the butterfly valve 28 and the butterfly valve 28 of the case 11, the hermeticity of the valve 28 can be secured.

Claims

1. A valve apparatus comprising a case for accommodating a valve and a body forming a fluid passage as separate constituent elements, wherein said case is fixed and disposed in said body.

2. A valve apparatus according to claim 1, wherein said case comprises a compact such as casting, and said body is made of metal or thin compact.

3. A valve apparatus according to claim 1 or 2, wherein said case has four ports.

4. A valve apparatus according to claim 3, wherein said body forms fluid passages which are in communication with four ports of said case.

5. A valve apparatus according to claim 3, wherein said body forms fluid passages which are in communication with three ports among the four ports of said case, and the remaining port is occluded.

6. A valve apparatus according to any one of claims 1 to 5, wherein said valve is a butterfly valve, and an abutment position between an outer peripheral edge of said butterfly valve and said butterfly valve of said case has a sealing structure.

Fig.1

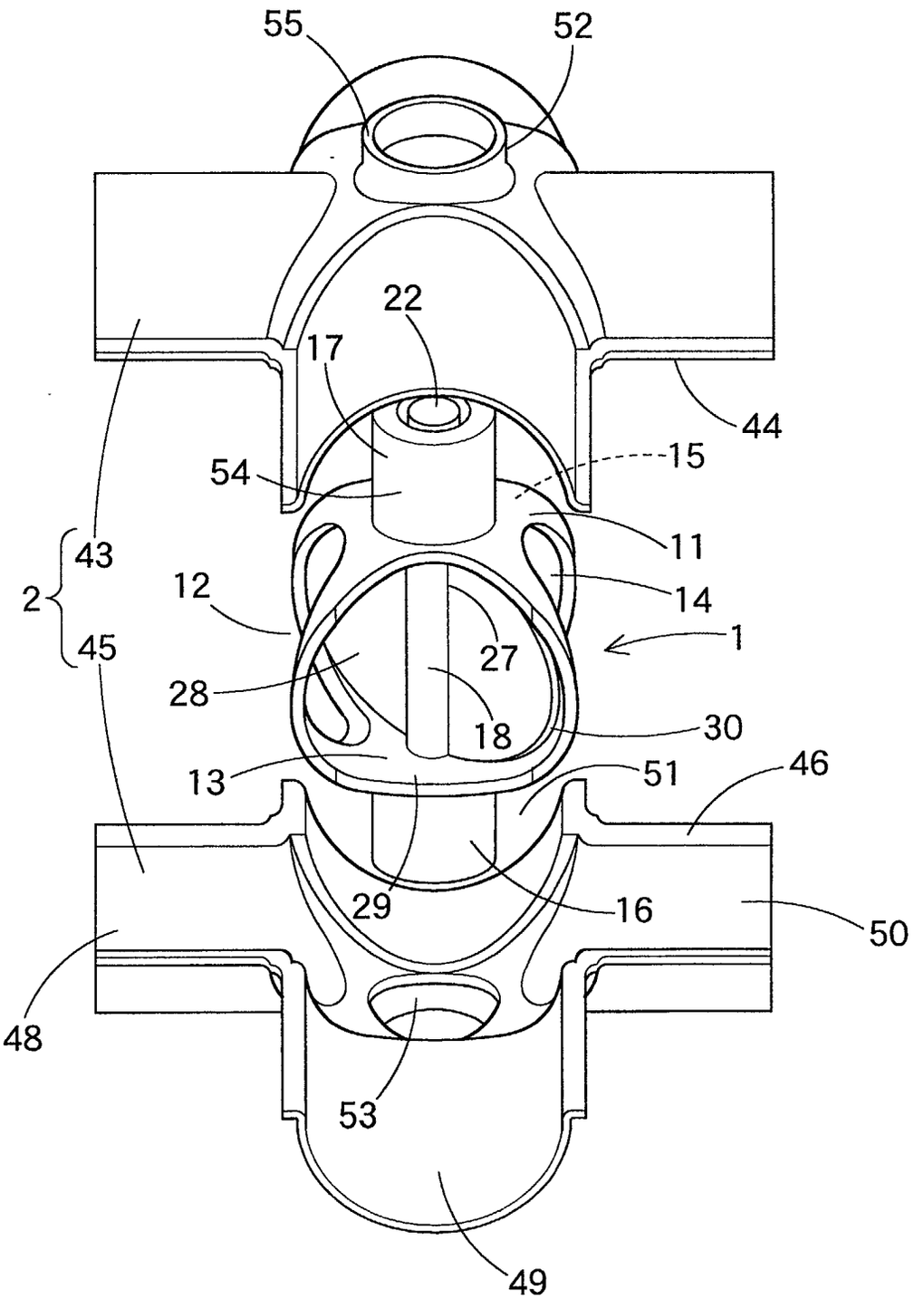

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Fig.2

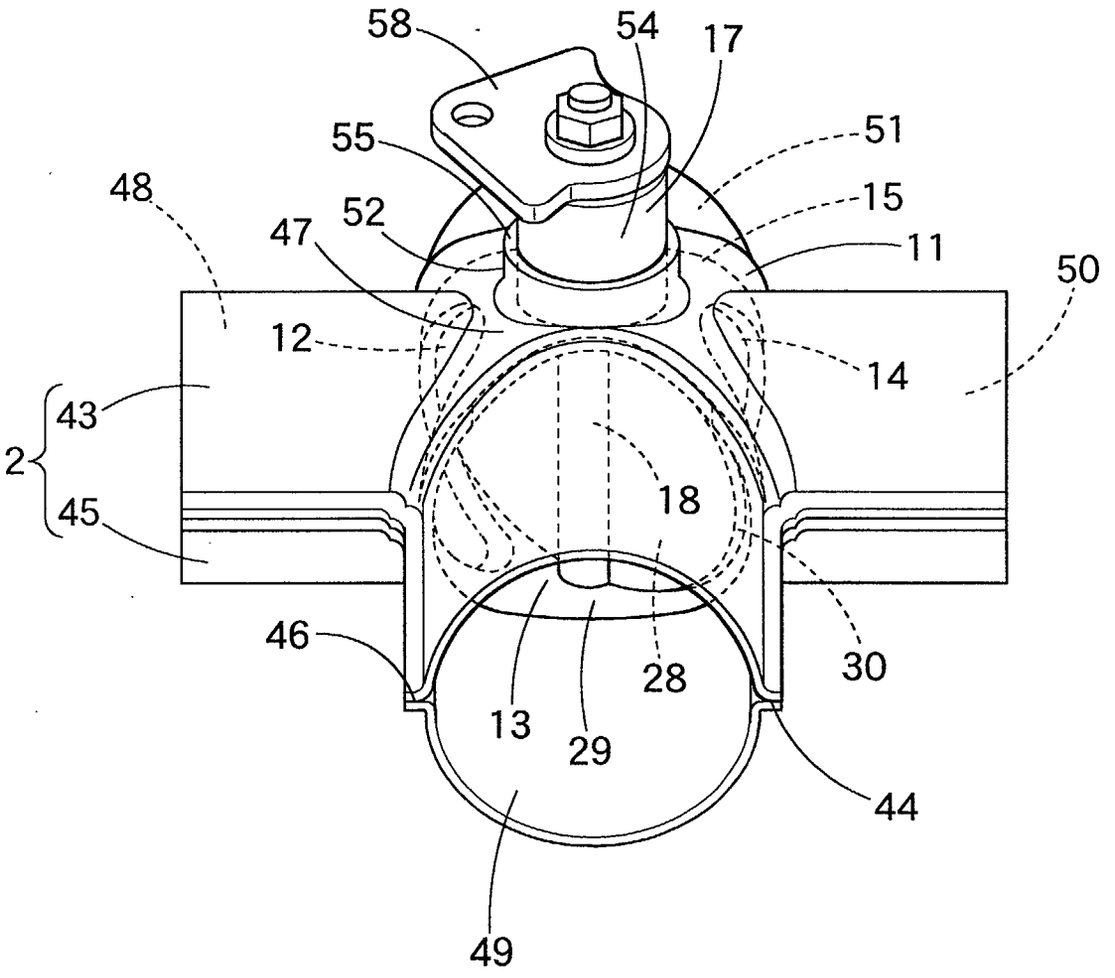

Fig.3

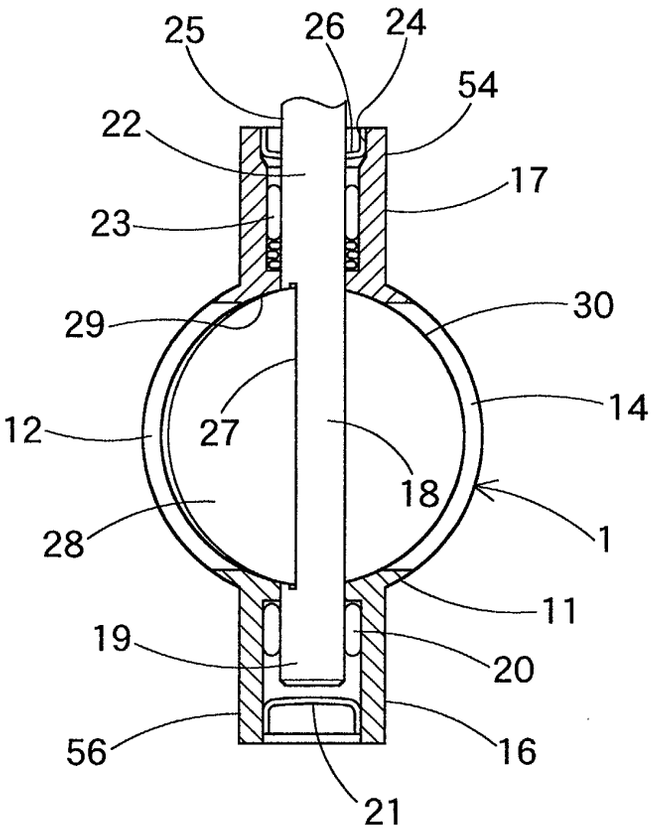
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Fig.4

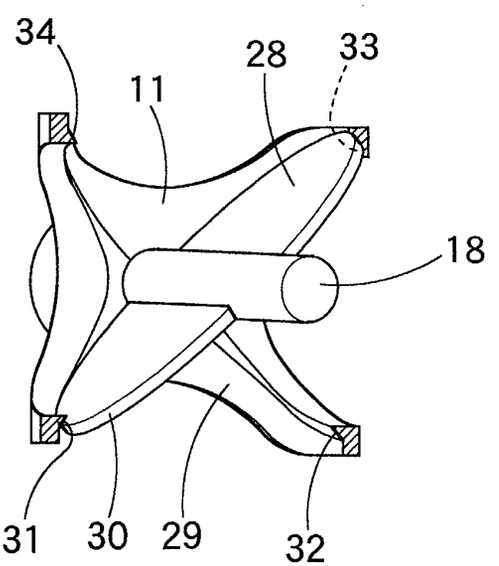
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Fig.5

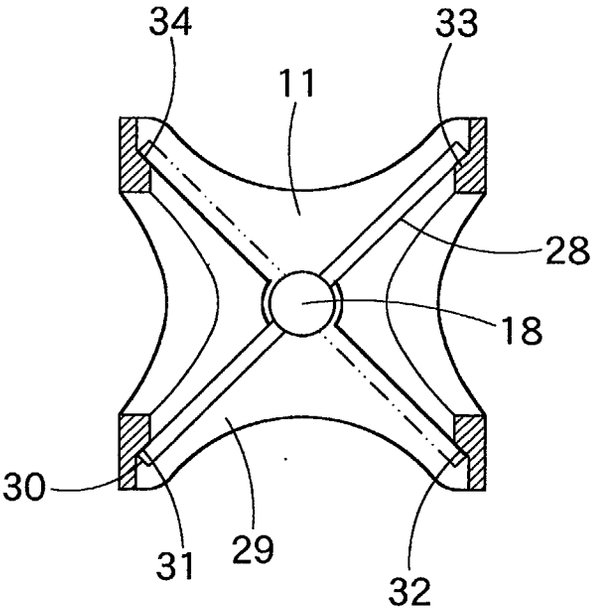

Fig.6

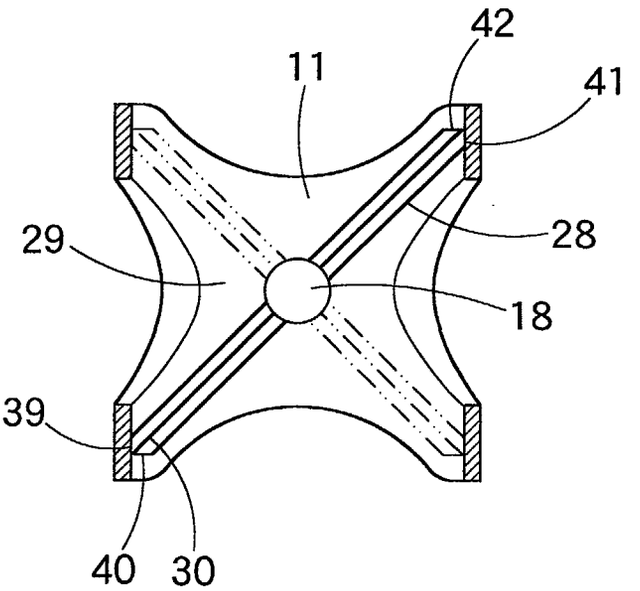

Fig.7

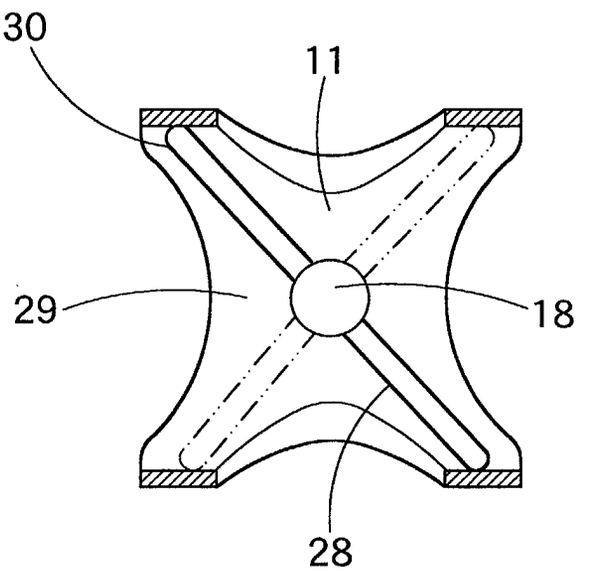

Fig.8

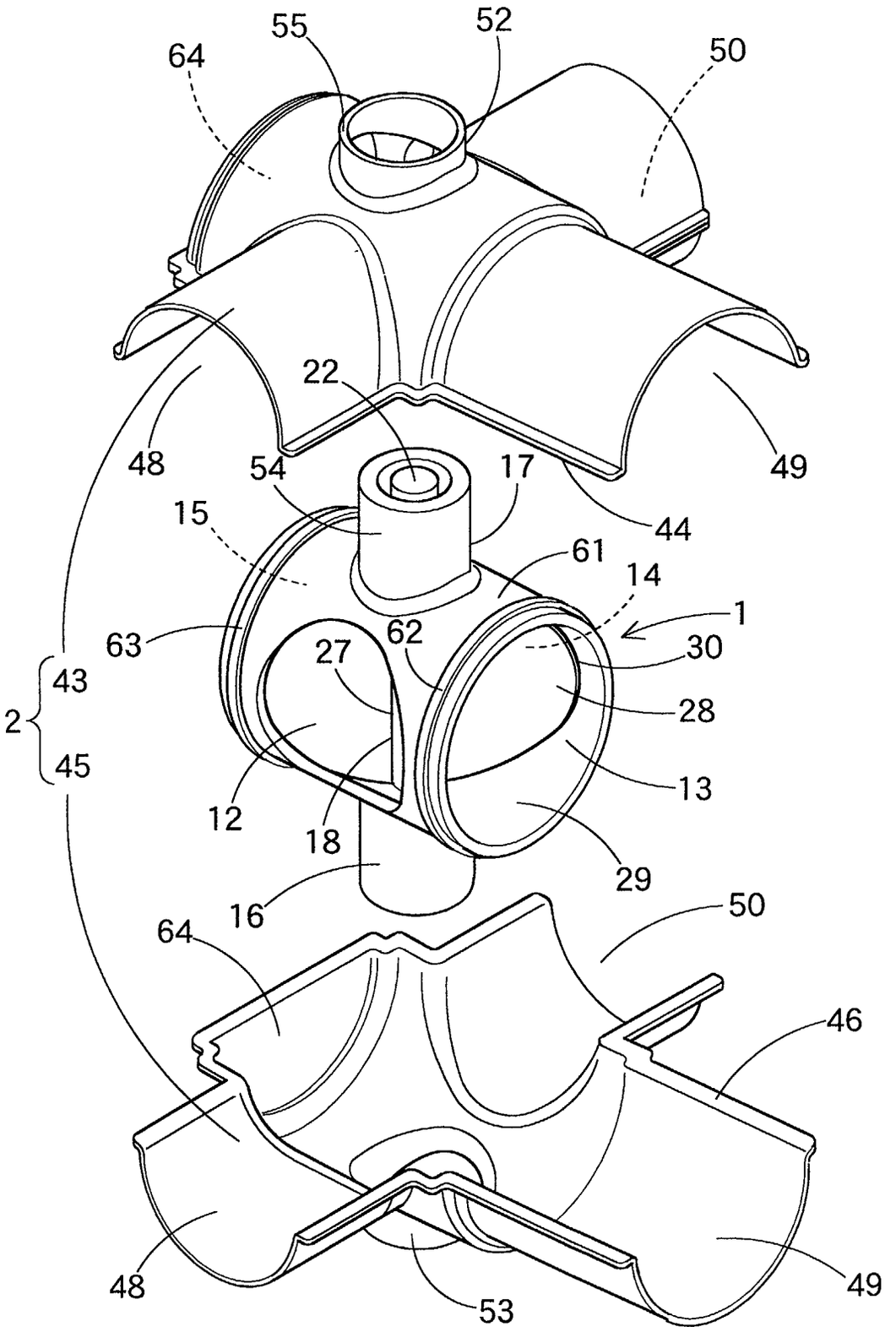
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Fig. 9

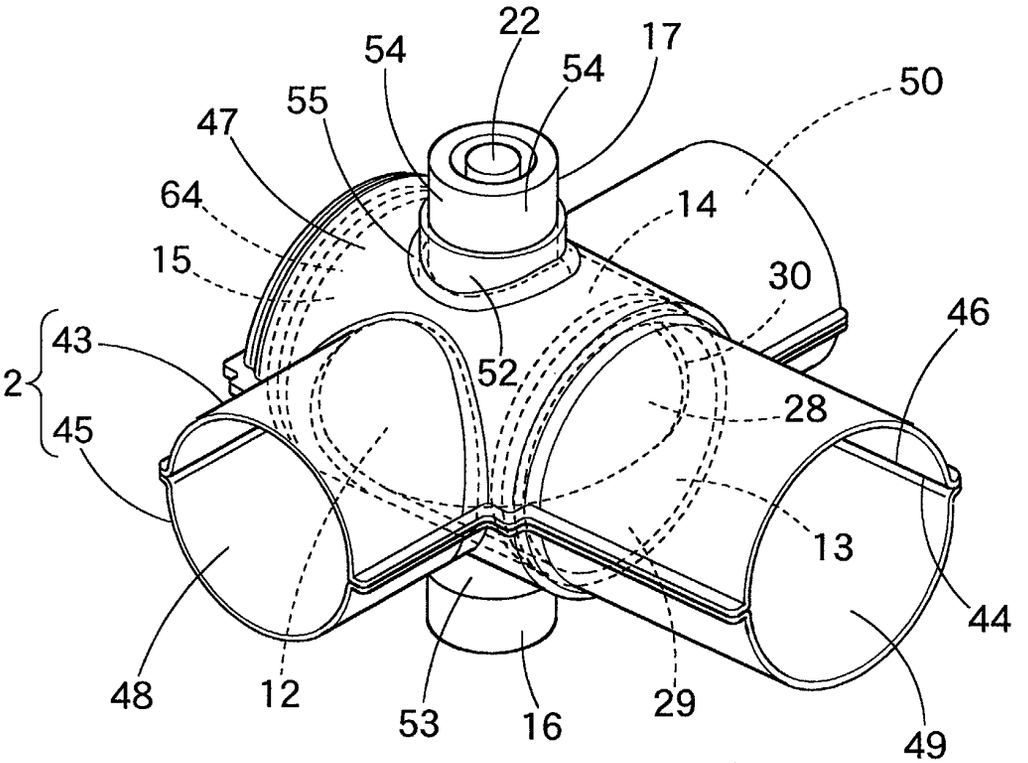
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Fig. 10

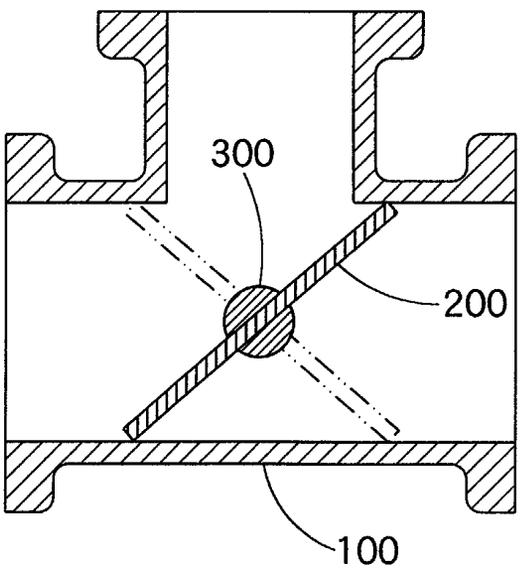
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Fig.11

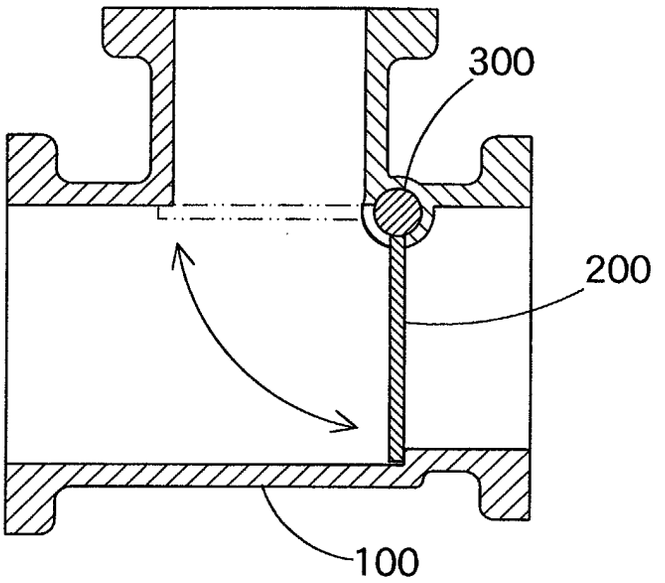

Fig.12