

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 548 993 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **92122063.8**(51) Int. Cl.⁵: **F01L 3/20**(22) Date of filing: **28.12.92**(30) Priority: **27.12.91 JP 359231/91**(43) Date of publication of application:
30.06.93 Bulletin 93/26(84) Designated Contracting States:
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W-8000 München 22 (DE)(54) **Two stroke internal combustion engine comprising a crankcase intake system controlled by a valve system.**

(57) The present invention relates to a two stroke internal combustion comprising a crankcase intake system wherein an intake charge is supplied to the engine through at least one intake port (42) of the crankcase, said intake port (42) being controlled by a reed valve system (48) comprising a plurality of reed valves. More specifically, the present invention relates to an internal combustion engine having a reed valve system (48) wherein said reed valve system (48) comprises paired upper and lower reed valves (58,59) wherein the lower reed valve (59) comprises upper and lower valve reeds (64) for controlling a plurality of downstream end openings (62b) whereas the upper reed valve (58) comprises a single valve reed (74).

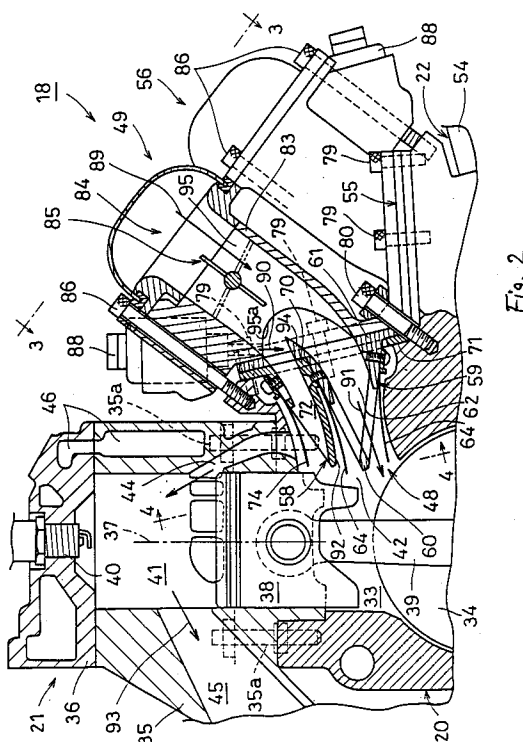


Fig. 2

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The present invention relates to a two stroke internal combustion engine comprising a crankcase intake system wherein an intake charge is supplied to the engine through at least one intake port of the crankcase, said intake port being controlled by a reed valve system comprising a plurality of reed valves.

A two stroke engine for a motorcycle is shown in JP-U-Hei-310236. In that case, the crankcase comprises an intake port with a reed valve installed therein to control the supply of an air/fuel mixture to the crankcase. The reed valve comprises a reed valve body protruding into the crankcase through the intake port and defining a suction passage formed therethrough and a valve reed for opening/closing the downstream end opening of the suction passage.

Moreover, it has also already been proposed to apply a plurality of intake valves arranged vertically one above the other as shown in JP-A-Hei-3286139. In that case, however, the fixing of the reed valves is relatively complicated. Moreover, from JP-A-Hei-240079, another intake system comprising a reed valve control means is known.

While the engine is operating, the mixture is introduced into the crankcase through the suction passage or passages of the reed valve system and is once precompressed here. Then, the precompressed mixture is introduced into the combustion chamber through the scavenging ports and is combusted to generate engine power.

In such reed valve control systems, if the suction resistance is lodged when the mixture passes through the suction passage in the reed valve body, the engine performance such as charging efficiency will be lowered. Therefore, in order to eliminate such inconveniences, it is desirable to enlarge the opening area of the downstream end opening of the suction passage defined through the one or plurality of reed valves. In order to cope with these problems, it has already been deliberated to protrude the reed valve body to a greater extent into the crankcase in order to enlarge the surface area of the reed valve body and to enlarge the opening area of the downstream end opening formed therethrough. However, it has to be assured that the protruded end of the reed valve body does not interfere with the crankshaft in the crankcase. Therefore, the amount of extension of the valve body into the crankcase is limited.

Therefore, it is an objective of the present invention to provide a two stroke internal combustion engine having a reed valve system which allows to improve the engine performance by means of enlarging the opening area of the downstream end opening of the suction passages formed through the reed valve system while assuring a serviceable and uncomplicated structure

of the system.

In order to perform said objective, the present invention comprises a two stroke internal combustion engine as indicated above wherein said reed valve system comprises paired upper and lower reed valves wherein the lower reed valve comprises upper and lower valve reeds for controlling a plurality of downstream end openings whereas the upper reed valve comprises a single valve reed.

The function of the structure above is as follows:

On the conventional 2-cycle engine, the reed valve body of only one reed valve is protruded into the crankcase and an suction passage is formed through this reed valve body, while, in the structure according to this invention, the reed valve system 48 is composed of upper and lower reed valves 58 and 59, and the reed valve bodies 60 and 70 of the upper and lower reed valves 58 and 59, respectively, are protruded into the crankcase 20.

Therefore, the surface area of the reed valve bodies 60 and 70 according to this invention can be made larger than that of the conventional reed valve body, the opening area of the downstream end openings 62b and 72b of the suction passages 62 and 72 formed through these reed valve bodies 60 and 70, respectively, can be made sufficiently large and, consequently, the suction resistance against the flow of the mixture 91 passing through the suction passages 62 and 72 can be reduced.

Further, if the opening areas of the downstream end openings 62b and 72b of the suction passages 62 and 72 are enlarged, the quantity of the mixture passing through unit area of these openings becomes smaller, and the valve opening deformation of each valve reed 64 or 74 can be smaller. Therefore, the responsiveness of the opening/closing action of these valve reeds 64 and 74 to the negative pressure in the crankcase 20 is improved.

Further, although stoppers are provided for preventing each valve reed 64 and 74 from excessively opening, the stopper surface 92 for preventing the valve reed 74 of the lower reed valve 59 from excessively opening is formed on the lower surface of the upper reed valve body 70 of the upper reed valve 58.

Therefore, no separate stopper is required for the valve reed 64 of the lower reed valve body 59.

In the case above, the structure of the reed valve system 48 may be such that each reed valve body 60 and 70 has an outward flange 61 and 71 formed on the base portion thereof, the outward flange formed on one reed valve body has an fitting hole 77 formed therethrough for fitting the other reed valve body thereinto, and, by thus fitting one reed valve body into the fitting hole of the other reed valve body, both of the outward flanges 61 and 71 are piled up and are installed together

on the crankcase 20 to support the reed valve system 48.

With this structure, both reed valve bodies 60 and 70 can be brought closer to each other as compared with the structure in which both reed valve bodies 60 and 70 have respective outward flanges 61 and 71 and these outward flanges 61 and 71 are installed on the crankcase individually side by side. That is, the reed valve system 48 can be made compact although the reed valve system 48 is composed of upper and lower reed valves 60 and 70.

Further, the base portions of both upper and lower reed valve bodies 60 and 70 may be fastened together through screws.

With this structure, the upper and lower reed valves 58 and 59 can be firmly united with each other.

Further preferred embodiments of the present invention are laid down in the other subclaims.

In the following the present invention is explained in greater detail by means of several embodiments thereof in conjunction with the accompanying drawings, wherein:

Figure 1 is an overall side view of a motorcycle with an engine according to the present invention,

Figure 2 is a vertical sectional view of the engine according to the first embodiment of the present invention seen with the cylinder axis disposed vertically,

Figure 3 is a view taken along the line 3-3 of Figure 2 for the first embodiment,

Figure 4 is a view taken along the line 4-4 of Figure 2 for the first embodiment,

Figure 5 is an exploded side view of a reed valve system of the first embodiment of the present invention,

Figure 6 is an exploded plan view of a reed valve system for the first embodiment according to the present invention,

Figure 7 is a view of a second embodiment of the present invention corresponding to Figure 2,

Figure 8 is a view of the second embodiment corresponding partially to Figure 3,

Figure 9 is a view of a third embodiment of the present invention corresponding to the view of Figure 2,

Figure 10 is a view of the third embodiment corresponding partially to Figure 3,

Figure 11 is a view of a fourth embodiment of the present invention corresponding partially to Figure 3,

Figure 12 is a view of a fifth embodiment of the present invention corresponding to Figure 5, and

Figure 13 is a view of the fifth embodiment of the present invention corresponding to Figure 6.

Figs.1 through 6 show a first embodiment of the present invention.

In Fig.1, the reference numeral 1 denotes a motorcycle as a sample of a vehicle. The arrow Fr in Fig. 1 shows the forward direction of the vehicle, and the right and the left in the following description are to be referred to this forward direction.

The body frame 2 of the motorcycle 1 has a head pipe 3 at its front end, and a main frame 4 extends rearward and downward from the head pipe 4. A rear arm bracket 5 extends downward from the rear end of the main frame 4.

The head pipe 3 steerably supports a front fork 7. The front fork 7 has a front wheel 8 borne on the lower end thereof, and a steering handle bar 9 fastened on the upper end thereof.

A rear arm 11 is pivoted by the rear arm bracket 5 for vertical swinging through a pivot shaft 10. A rear wheel 12 is borne on the swinging end of the rear arm 11, and a shock absorber 13 is installed between the rear end of the main frame 4 and the rear arm 11. A seat frame is protruded rearward and upward from the rear end of the main frame 4, and a seat 16 is mounted on this seat frame.

An engine 18 is installed under the main frame 4 and is supported on the main frame 4 and the rear arm bracket 5 through the pivot shaft 10 and bolts 19. This engine 18 is a 4-cylinder 2-cycle one, and the left and right lower cylinder assemblies 21 thereof are protruded forward and downward from the front lower side of the crankcase 20 thereof, and the left and right upper cylinder assemblies 22 thereof are protruded forward and upward from the front upper side of the crankcase 20 thereof. The intersecting angle made between the axes of the lower cylinder assemblies 21 and the upper cylinder assemblies 22 is about 90 degrees as seen sideways.

A power transmission system 24 is connected to the rear portion of the crankcase 20, and a transmission chain 27 is wound around the output sprocket wheel 25 of the transmission system 24 and the input sprocket wheel 26 secured on the rear wheel 12. The power of the engine 18 is transmitted to the rear wheel 12 through the transmission chain 27, etc., so that the motorcycle 1 may travel on the road surface 28.

The numerals 30 and 31 denote the fuel tank and the exhaust pipe.

In Figs. 2, 3 and 4, paired upper and lower crankshafts 34 extending in the left-right direction are borne in the crank chamber 33 in the crankcase 20. The lower cylinder assembly 21 has a cylinder 35 protruding forward and downward from the front lower side of the crankcase 20, and this cylinder 35 is fastened on the crankcase 20 through left and right bolts 35a.

A cylinder head 36 is fastened on the protruding end of the cylinder 35. A piston 38 is fitted in the cylinder 35 slidably along the axis 37 thereof, and this piston 38 is connected with the lower one 34 of both crankshafts 34 through a connecting rod 39.

The space surrounded by the cylinder 35, cylinder head 36 and the piston 38 constitutes a combustion chamber 41, and an ignition plug 40 facing into the combustion chamber 41 is installed on the cylinder head 36. The crankcase 20 has an intake port 42 so formed therethrough as to lead to the crank chamber 33. This intake port 42 is formed through the portion of the crankcase 20 between the left and right bolts 35a. Further, the cylinder 35 has a scavenging port 44 so formed therethrough as to communicate the crank chamber 33 with the combustion chamber 44. On the other hand, an exhaust port 45 is so formed as to communicate the combustion chamber 44 with the outside, and the exhaust pipe 31 is connected to the exhaust port 45. The cylinder 35 and the cylinder head 36 have water jackets 46 formed therethrough.

A reed valve system 48 and a throttle valve 49 are connected to the intake port 42 in order toward the upstream of the intake flow, and these valves 48 and 49 are disposed between the lower cylinder assembly 21 and the upper cylinder assembly 22. The running wind is introduced into the throttle valve 49 through an air introducing pipe protruded forward of the head pipe 3.

In Figs. 1, 2 and 3, the upper cylinder assembly 22 has the same structure as the cylinder assembly 21 and has a cylinder 54, etc. The intake port formed for the cylinder 54 through the crankcase 20 is provided with another reed valve system 55 and another throttle valve 56 having the same structure as the reed valve system 48 and the throttle valve 49 for the lower cylinder assembly 21. The reed valve system 55 and the throttle valve 56 are disposed adjacent to the reed valve system 48 and the throttle valve 49 for the lower cylinder assembly 21.

Further, the piston of the upper cylinder assembly 22 is connected with the upper one 34 of both crankshafts 34 through a connecting rod. Both crankshafts 34 are coupled with each other through a chain, and the input shaft of the power transmitting system 24 is connected to one of the crankshafts 34.

In Figs. 2, 4, 5 and 6, this embodiment is described with the axis 37 of the cylinder 35 of the lower cylinder assembly 21 disposed vertically for convenience of description.

The reed valve system 48 is composed of paired upper and lower reed valves 58 and 59.

The lower reed valve 59 has a lower reed valve body 60 formed like a box having a generally V-shaped vertical cross-section. This lower reed valve body 60 is tapered toward the crank chamber 33, and has an outward flange 61 formed integrally at the base portion thereof. The lower reed valve body 60 has a suction passage 62 formed therethrough. The upstream end opening 62a of the suction passage 62 is opened through the base portion end of the lower reed valve body 60. The downstream end opening 62b of the suction passage 62 is constituted of four openings formed respectively through the upper and lower walls of the lower reed valve body 60. All of these downstream end openings 62b are of the same shape and size as one another, and are arranged side by side in line in the left-right direction.

The lower reed valve 59 is provided with upper and lower valve reeds 64 for openably closing these downstream end openings 62b respectively. The upper valve reed 64 is fastened at one end thereof on the upper wall surface of the base portion of the lower reed valve body 60 through first screws 66. Similarly, the lower valve reed 64 is fastened at one end thereof on the lower wall surface of the base portion of the lower reed valve body 60 through second screws 68 together with a stopper 67.

On the other hand, the upper reed valve 58 has an upper reed valve body 70 formed like a box having arcuate vertical cross-section. This upper reed valve body 70 is tapered toward the crank chamber 33, and has an outward flange 71 formed integrally at the base portion thereof.

The upper reed valve body 70 has a suction passage 72 formed therethrough. The upstream end opening 72a of the suction passage 72 is opened through the base portion end of the upper reed valve body 70. The downstream end opening 72b of the suction passage 72 is constituted of three openings formed through the upper wall of the upper reed valve body 70. All of these downstream end openings 72b are of the same shape and size as one another, and are arranged side by side in line in the left-right direction.

The upper reed valve 58 is provided with a valve reed 74 for openably closing the downstream end openings 72b, and the valve reed 74 is fastened at one end thereof on the upper wall surface of the base portion of the upper reed valve body 70 through third screws 76 together with a stopper 75.

The outward flange 71 of the upper reed valve 58 has a fitting hole 77 formed therethrough, the lower reed valve body 60 is fitted into this fitting hole 77 from rear, and both outward flanges 61 and 71 are piled up together. In this case, the lower wall of the base portion of the upper reed valve

body 70 is fastened, together with the valve reed 64, on the upper wall of the base portion of the lower reed valve body 60 through the first screw 66 by which the upper and lower reed valves 58 and 59 are firmly united.

Further, the upper reed valve body 70 has a tool hole 78 formed through the upper wall of the base portion thereof for allowing the first screw 66 and a tightening tool therefor to reach the hole for the first screw 66 bored through the lower wall of the upper reed valve body 70. This tool hole 78 is closed with the valve reed 74 fastened on the upper reed valve body 70.

In Figs.1, 3 and 4, both outward flanges 61 and 71 are detachably fastened integrally on the opening edge of the intake port 42 through first and second mounting bolts 79 and 80. The second bolt 80 functions also for fastening the reed valve system 55 for the upper cylinder assembly 22. Further, the outward flange 61 of the lower reed valve body 50 has a communicating hole 81 formed therethrough to communicate the space within the throttle valve 49 with the space within the upper reed valve body 70.

The throttle valve 49 has a throttle body 83 to be connected to the outward flanges 61 and 71, and the intake passage 84 in the throttle body 83 is provided with a flap type throttle valve body 85.

The throttle body 83 is detachably fastened on the crankcase 20 through first and second fastening bolts 79 and 80. The throttle body 83 is detachably fastened on the crankcase 20 also through a third fastening bolt 86. That is, The reed valve system 48 and the throttle body 83 are detachably fastened together on the crankcase 20 through first, second and third fastening bolts 79, 80 and 86.

In Figs.5 and 6, a gasket 87 is interposed between both outward flanges 61 and 71. By exchanging this gasket 87 with one having different thickness, the relative position of the upper reed valve 58 and the lower reed valve 59 can be adjusted.

In Figs.1 and 3, a fuel injection valve 88 is installed through the upper wall of the throttle body 83 near the left-right center thereof.

When the piston 38 begins to rise from the bottom dead center while the engine 18 is operating, the air 89 outside the engine 18 is suctioned into the intake passage 84 in the throttle body, and fuel 90 is injected toward this air 89 by the fuel injection valve 88.

Further, the mixture 91 of the air 89, intake air, and the fuel 90 is suctioned into the crank chamber 33 through the suction passages 62 and 72 of the lower and upper reed valve bodies 60 and 70, respectively. Here, both valve reeds 64 and 74 are elastically deformed and automatically opened by the negative pressure in the crank chamber 33

caused by the rise of the piston 38, and allows the mixture 91 to pass therethrough. The valve reeds 64 and 74 are prevented from excessively opening by the touch of the elastically deformed portion thereof with the stoppers 67 and 75, with the arcuately convex stopper surface formed on the upper and lower inner surfaces of the intake port 42 or with the arcuately convex stopper surface 92 formed on the lower surface of the upper reed valve body 70.

Further, while the piston 38 is rising, the mixture 91 which has been sent into the combustion chamber 41 is compressed by this piston 38.

When the piston 38 approaches the top dead center, the mixture 91 in the combustion chamber 41 is sufficiently compressed, and is ignited by the ignition plug 40 to be combusted.

Then, the piston 38 is pushed down. In this while, the valve reeds 64 and 74 are automatically closed by the pressure within the crank chamber 33, and the mixture 91 suctioned into the crank chamber 33 as described above is prevented from flowing backward. This mixture 91 is precompressed, and the precompressed mixture 91 is sent into the combustion chamber 41 through the scavenging port 44. On the other hand, the combusted gas 93 produced by combustion in the combustion chamber 41 is exhausted through the exhaust port 45.

When the piston 38 rises the next time, the actions above are repeated and power is outputted from the engine 18.

Since the left-right width l of the upper reed valve body 70 is smaller than that L of the lower reed valve body 60 as shown in Fig.4, the left and right side portions of the upper reed valve body 70 will not interfere with the bolts 35a for fastening the cylinder 35 on the crankcase 20.

On the other hand, since the lower reed valve body 60 is positioned under the upper reed valve body 70 and does not interfere with the bolts 35a, the width L of the lower reed valve body 60 is enlarged irrespective of this bolt 35a, and the sectional area of the suction passage 62 of the lower reed valve body 60 is enlarged. Therefore, since the total sectional area of the suction passages 62 and 72 becomes larger and the suction resistance against the flow of the mixture 91 through these suction passages 62 and 72 is restrained from increasing, the charging efficiency of the engine 18 is improved.

Further, since the quantity of the mixture 92 flowing through unit area of the downstream end openings 62b and 72b decreases as much as the total sectional area of the suction passages 62 and 72 is enlarged as described above, the valve opening deformation of each valve reed 64 and 74 can be smaller. Therefore, the responsiveness of the

opening and closing actions of these valve reeds 64 and 74 to the negative pressure in the crank chamber 33 is improved, which also improves the engine performance.

Further, in addition to the fact that the upper and lower reed valves 58 and 59 have respective width dimensions different from each other, the down stream end openings 62b of the suction passage 62 formed through the upper reed valve 58 are formed in one row in the left-right direction, while the down stream end openings 72b of the suction passage 72 formed through the lower reed valve 59 are formed in two, upper and lower, rows in the left-right direction.

Therefore, larger portion of the mixture 91 will pass through the suction passage 62 of the lower reed valve 59 than through the suction passage 72 of the upper reed valve 58, that is, the mixture 91 will be suctioned from the scavenging port 44 into the crank chamber 33 more through the suction passage 62 of the lower reed valve 59 which is positioned farther from the scavenging port 44 than the upper reed valve 58.

Therefore, the mixture 91 suctioned into the crank chamber 33 through the reed valve system 48 is prevented from short-circuitedly flowing into the scavenging port 44 and is sent into the combustion chamber 41 through the scavenging port 44 after being sufficiently mixed in the crank chamber 33. Consequently, the mixture 91 is securely ignited and combusted in the combustion chamber 41, which improves the performance of the engine 18.

At the portion where the air 89 or the mixture 91 flows separately into the lower reed valve body 60 and into the upper reed valve body 70, a rectifier plate 94 for rectifying these flows is integrally protruded from the outward flange 61 of the lower reed valve body 59. This rectifier plate 94 prevents the boundary layer of the mixture 91 flowing into each suction passage 62 and 72 from breaking away, which prevents the suction resistance from increasing.

Further, by selecting the fuel injecting direction of the fuel injection valve 88 and selecting the form and the protruding direction of the rectifier plate 84, the distribution of the fuel injection amounts into respective suction passages 62 and 72 can be determined as desired.

Both upstream end openings 62a and 72a are formed like a narrow rectangle which is long in the left-right direction individually and also as a whole.

On the other hand, the intake passage 84 in the throttle body 83 is composed of paired left and right passages 84a and 84a each having a circular cross-section, and a partitioning wall 95 is interposed between both passages 84a and 84a.

The intake passage 84 is composed of paired left and right passages 84a and 84a in correspondence to the rectangular narrow and long overall form of the upstream end openings 62a and 72a as described above so that the cross-sectional area change at the transition from the intake passage 84 of the throttle body 83 to the suction passages 62 and 72 of the reed valve system 48 may become smaller. Therefore, the mixture 91 from the intake passage 84 smoothly flows into the suction passages 62 and 72, and the suction resistance is restrained from increasing.

The throttle valve body 85 is composed of circular valve flaps 85a and 85a each disposed in each passage 84a. These valve flaps 85a are individually opened and closed, and only one of these valve flaps 85a is operated in the low speed operating range of the engine 18, while both valve flaps are operated simultaneously in the high speed operating range of the engine. In the latter case, both valve flaps may be constructed to be integrally operated.

The structures above are the same for the upper cylinder assembly 22 and for the reed valve system 55 and the throttle valve 56 corresponding thereto.

Further, the engine 18 may be constructed of a single lower cylinder assembly 21 and a single upper cylinder assembly 22 having respective cylinder axes intersecting each other with an angle of 90 degrees as seen sideways, and, in this case, the lower and upper cylinder assemblies drive a single crankshaft 34. The number of the downstream end openings 62b and 72b of the reed valve system 48 is not limited to that for the embodiment above, but may be single or plural other than that for the embodiment above.

Figs.7 through 11 show second through fourth embodiments. For the structures and functions of these embodiments common to those of the first embodiment, their descriptions are omitted by giving them the same reference numerals on the drawings, and only portions different from those of the first embodiment are described hereafter.

Figs.7 and 8 show a second embodiment.

In this embodiment, the fuel injection valve 88 is installed on each of the passages 84a through the lower wall of the throttle body 83, and the center of the fuel injecting direction thereof is directed into the lower reed valve body 60. Since the opening area of the suction passage 62 of this lower reed valve body 60 is large, the fuel 90 smoothly flows into the crank chamber 33.

Figs.9 and 10 show a third embodiment.

In this embodiment, the fuel injection valve 88 is installed on each of the passages 84a through the left and right outside walls of the throttle body 83, and the centers of the fuel injecting directions

thereof are directed nearly toward the boundary portions of the upper and lower reed valve bodies 60 and 70 so that fuel 90 may be evenly supplied into both suction passages 62 and 72.

Fig.11 shows a fourth embodiment.

In this embodiment, the fuel injection valve 88 is installed on each of the passages 84a through the upper wall of the throttle body 83.

Figs.12 and 13 show a fifth embodiment.

In this embodiment, a fitting hole 77 is formed through the outward flange 61 of the lower reed valve body 59, and the upper reed valve body 70 is inserted in this fitting hole 77 from rear thereof. A communicating hole 81 is formed through the outward flange 71 of the upper reed valve 58, and this communicating hole 81 leads into the lower reed valve body 60.

Further, the first screw 66 is screwed into the lower wall of the upper reed valve body 70 through the upper wall of the lower reed valve body 60, and the tool hole 78 is formed through the lower wall of the lower reed valve 60.

In the structure according to this invention, since the reed valve system is composed of upper and lower reed valves and the reed valve bodies of these upper and lower reed valves are respectively protruded into the crankcase, the surface area of the reed valve bodies according to this invention can be made larger than that of the conventional single reed valve body, the opening area of the downstream end openings of the suction passages formed through these reed valve bodies can be made sufficiently large and, consequently, the suction resistance against the flow of the mixture passing through the suction passages can be reduced, and the engine performance such as the charging efficiency, etc., thereof can be improved.

Further, when the opening areas of the downstream end openings of the suction passages are enlarged, the quantity of the mixture passing through unit area of these openings becomes smaller, and the valve opening deformation of each valve reed can be smaller. Therefore, the responsiveness of the opening/closing action of these valve reeds to the negative pressure in the crankcase is improved.

Further, although stoppers are provided for preventing each valve reed from excessively opening, the stopper surface for preventing the valve reed of the lower reed valve from excessively opening is formed on the lower surface of the upper reed valve body of the upper reed valve. Therefore, no separate stopper is required for the valve reed of the lower reed valve, and the reed valve is simplified and is made compact as much.

In the case above, the structure of the reed valve system may be such that each reed valve body has an outward flange formed on the base

portion thereof, the outward flange formed on one reed valve body has an fitting hole formed therethrough for fitting the other reed valve body therinto, and, by thus fitting one reed valve body into the fitting hole of the other reed valve body, both of the outward flanges are piled up and are installed together on the crankcase to support the reed valve system.

With this structure, both reed valve bodies can be brought closer to each other as compared with the structure in which both reed valve bodies have respective outward flanges and these outward flanges are installed on the crankcase individually side by side. That is, the reed valve system can be made compact although the reed valve system is composed of upper and lower reed valves.

Further, the base portions of both reed valve bodies may be fastened together through screws.

With this structure, the upper and lower reed valves can be firmly united with each other, and a sufficient strength can be secured for this reed valve system in this case also although it is composed of two reed valves.

To sufficiently enlarge the opening area of the downstream end opening of the suction passage formed through the reed valve body to improve the engine performance such as the charging efficiency thereof, etc., with a simple structure.

The reed valve system 48 to be installed on the intake port 42 of the crankcase 20 is composed of paired upper and lower reed valves 58 and 59 as seen with the axis 37 of the cylinder disposed vertically. These upper and lower reed valves 58 and 59 are constructed of box-like reed valve bodies 60 and 70 protruded into the crankcase 20 through the intake port 42, suction passages 62 and 72 formed respectively through the reed valve bodies 60 and 70, and valve reeds 64 and 74 for opening/closing the downstream end openings 62b and 72b of the suction passages 62 and 72, respectively. A stopper surface 92 for preventing the valve reed 64 of the lower reed valve 59 from excessively opening is formed on the lower surface of the reed valve body 70 of the upper reed valve 58.

Claims

1. Two stroke internal combustion engine comprising a crankcase intake system wherein an intake charge is supplied to the engine (18) through at least one intake port (42) of the crankcase (20), said intake port (42) being controlled by a reed valve system (48) comprising a plurality of reed valves (58,59)

characterized in that

said reed valve system (48) comprises paired upper and lower reed valves (58,59) wherein

the lower reed valve (59) comprises upper and lower valve reeds (64) for controlling a plurality of downstream end openings (62b) whereas the upper reed valve (58) comprises a single valve reed (74).

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2. Two stroke internal combustion engine as claimed in claim 1,

characterized in that

a stopper means (92) is provided for a valve reed (74) of at least one of the reed valves (59) for preventing said reed valve (59) from opening excessively.

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3. Two stroke internal combustion engine as claimed in claims 1 or 2,

characterized in that

said plurality of reed valves (58,59) is disposed vertically one above the other protruding from the crankcase (20), each reed valve (58,59) comprising a reed valve body (60,70) protruding into said crankcase (20) through said intake port (42) and a valve reed (64,74) for opening or closing a suction passage (62,72) extending through said reed valve body (60,70), respectively.

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4. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-3,

characterized by

paired upper and lower reed valves (58,59) wherein a stopper surface (92) is provided at the lower surface of the valve body (70) of the upper reed valve (58).

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5. Two stroke internal combustion engine,

characterized in that

each reed valve body (60,70) comprises an outward flange (61,71) at the base portion thereof, and that one of said flanges (61,71) comprises a fitting hole (77) for accommodating the valve body of another reed valve therein so that said reed valve system (48) is installed at the crankcase (20) with both of said outward flanges (61,71) piled up.

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6. Two stroke internal combustion engine as claimed in claim 5,

characterized in that

the base portions of the reed valve bodies (60,70) are fastened to each other by screws.

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7. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-6,

characterized in that

the lower reed valve (59) comprises a lower

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box-shaped reed valve body (60) having a generally V-shaped vertical cross-section whereas the lower box-shaped reed valve body comprises a generally arcuate vertical cross-section.

8. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-7,

characterized in that

the upper and lower valve reeds (64) of the lower reed valve (59) are fastened at one end thereof to upper and lower wall surfaces of a base portion of the lower reed valve body (60) with the lower valve reed (64) being fastened together with a stopper (67).

9. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-8,

characterized in that

the single valve reed (74) of the upper reed valve (58) is fastened at one end thereof to the upper wall surface of a base portion of the upper reed valve body (70) together with a stopper (75).

10. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-9,

characterized in that

the relative position between the upper and lower reed valves (58,59) is adjustable through gaskets (87) of different thickness which are selectively interposed between the outward flanges (61,71) of the two reed valves (58,59).

11. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-10,

characterized in that

the valve reeds (64,74) of the upper and lower reed valves (58,59) are elastically deformed and automatically opened by the negative pressure in a crank chamber (33) of the crankcase (20) but are prevented from excessively opening by the abutment against the stoppers (67,75) which are provided through an arcuately convex stopper surface formed at the upper and lower inner surfaces of the intake port (42) or through the arcuately convex stopper surface (92) formed at the lower surface of the upper reed valve body (70).

12. Two stroke internal combustion engine as claimed in at least one of the preceding claims 1-11,

characterised in that

a rectifier plate (94) is provided at a position where the air (89) or the air/fuel mixture (91) flows separately into the suction passages (62,72) of the upper and lower reed valve bodies (60,70), said rectifier plate (94) being supported through the outward flange (61) of the lower reed valve body (59). 5

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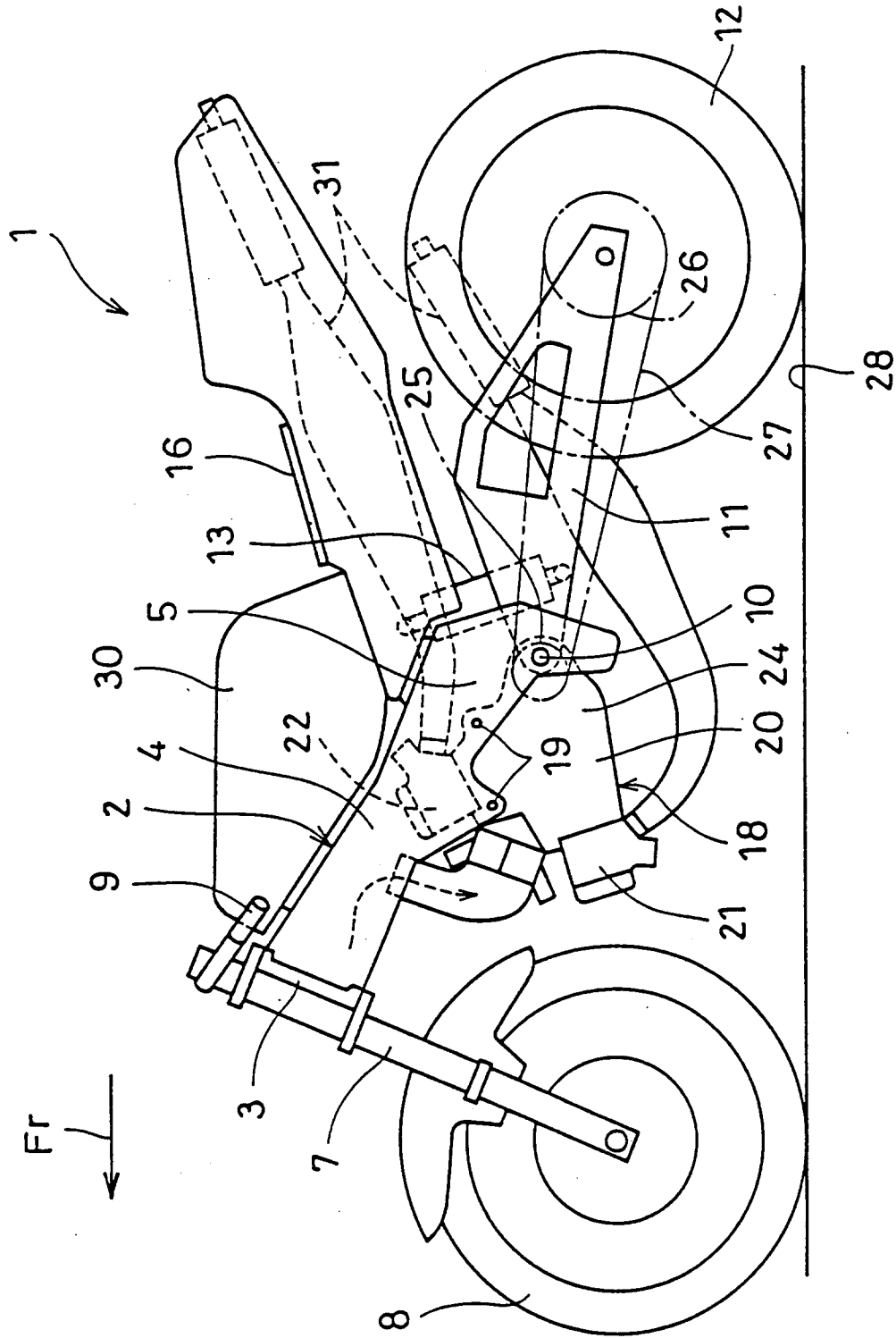


Fig. 1

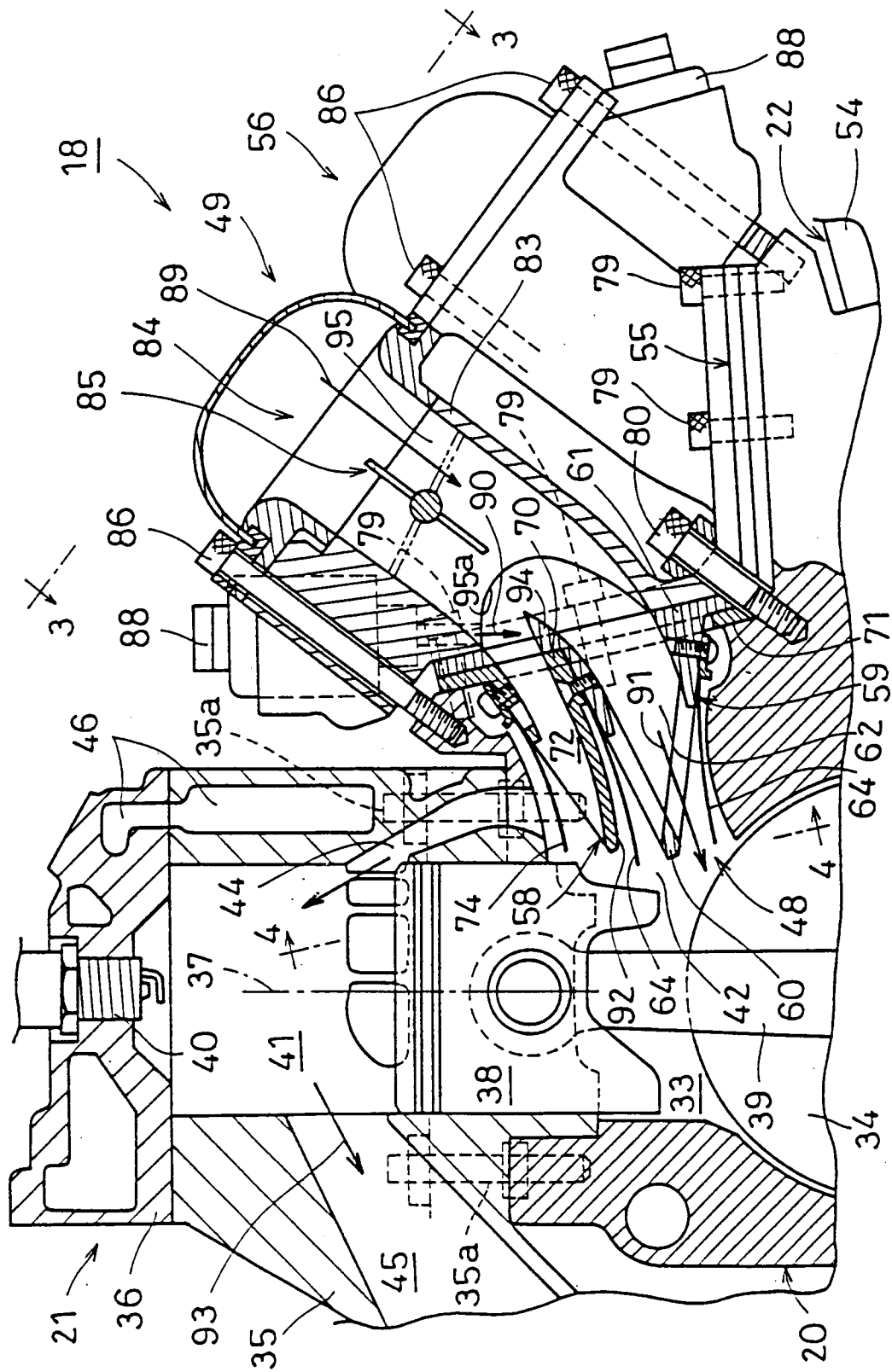


Fig. 2

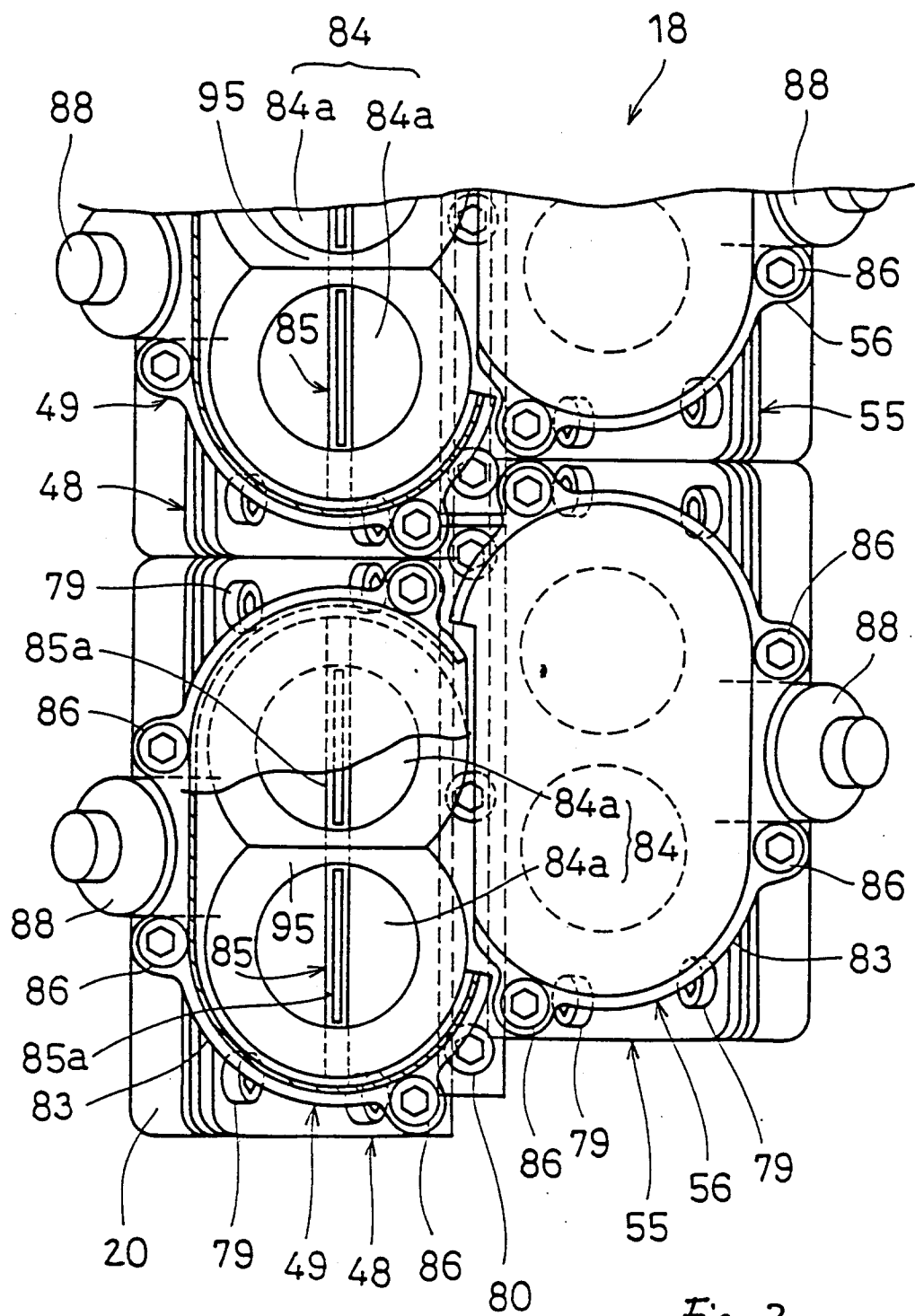
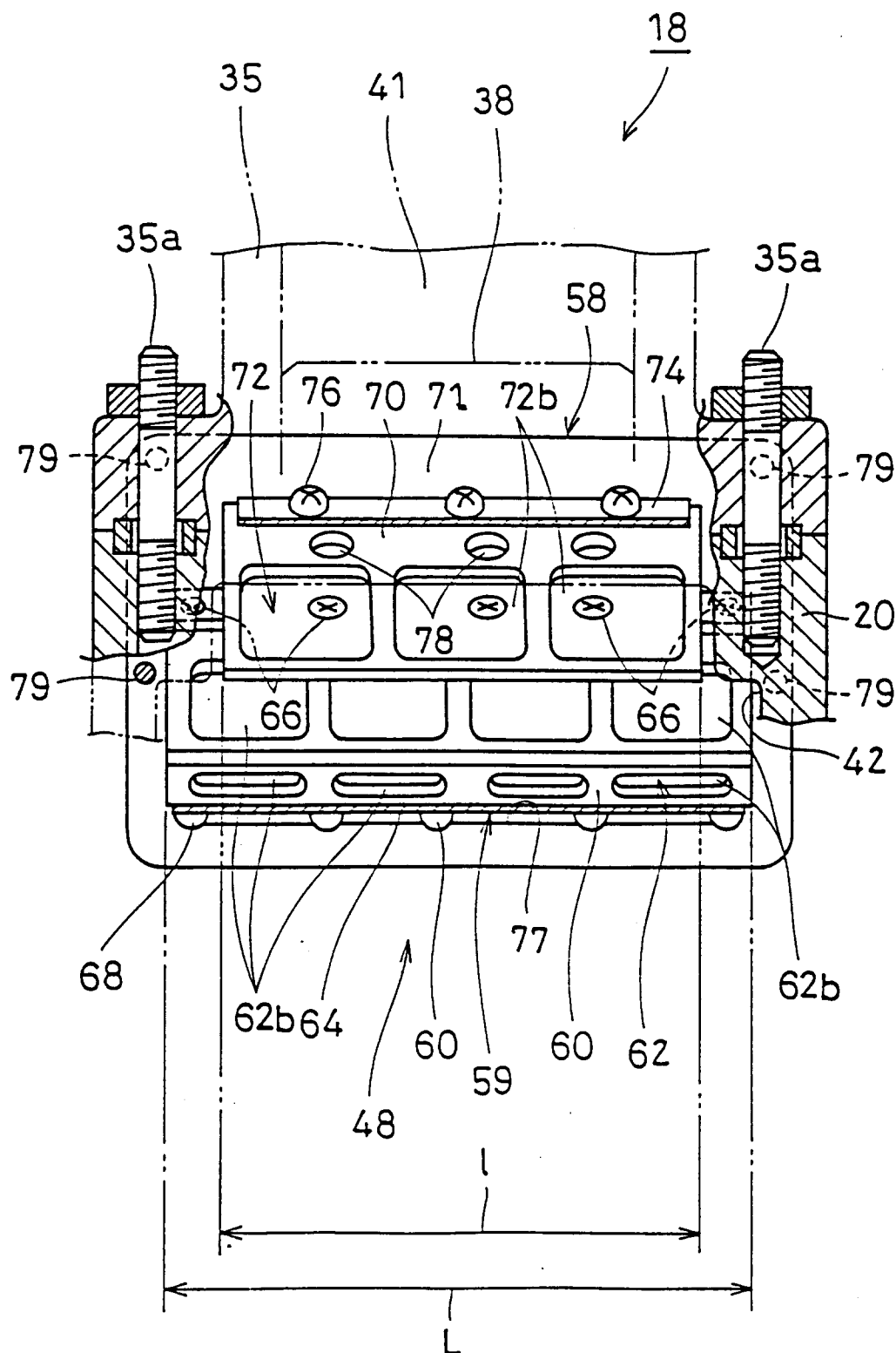


Fig. 3

Fig. 4



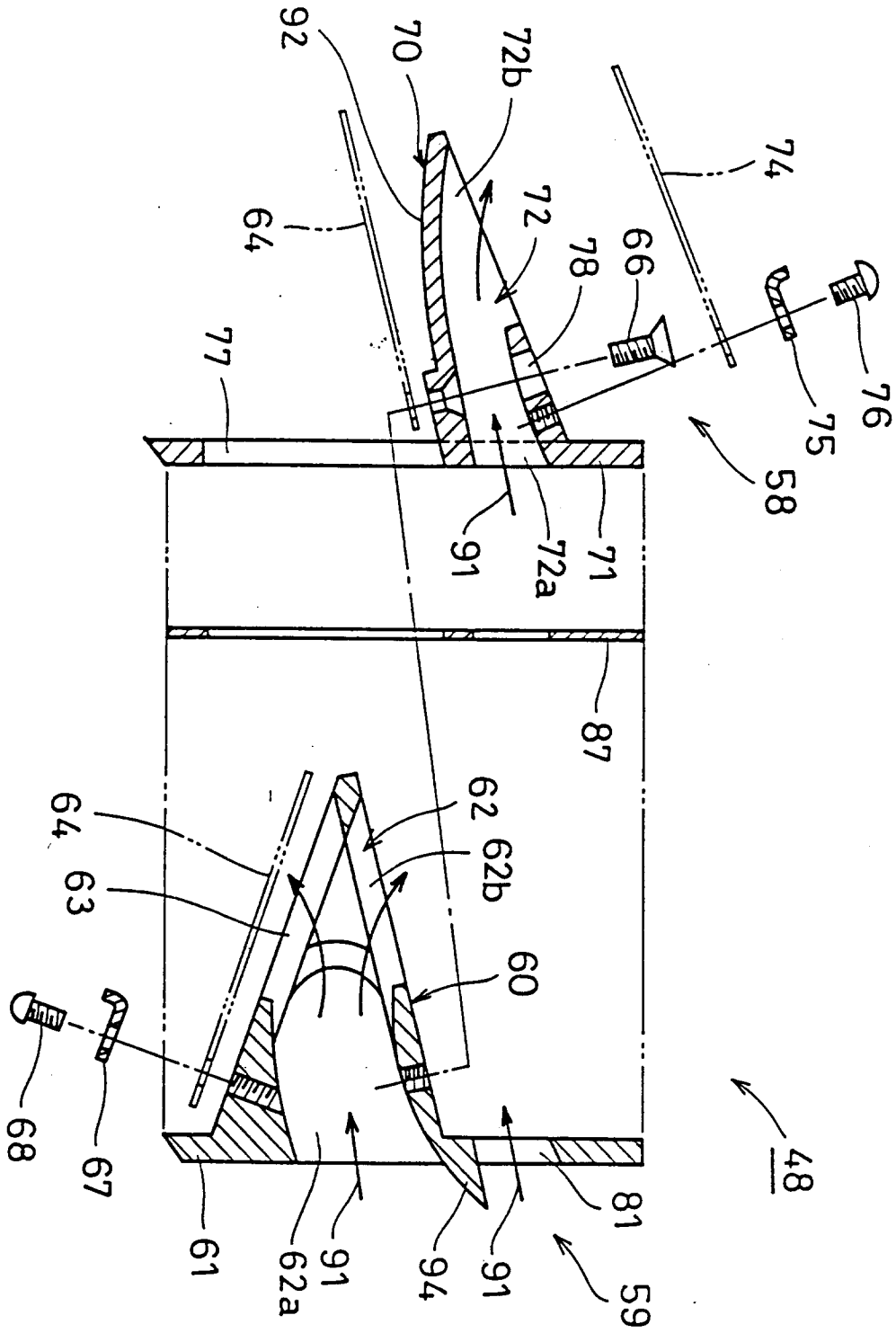


Fig. 5

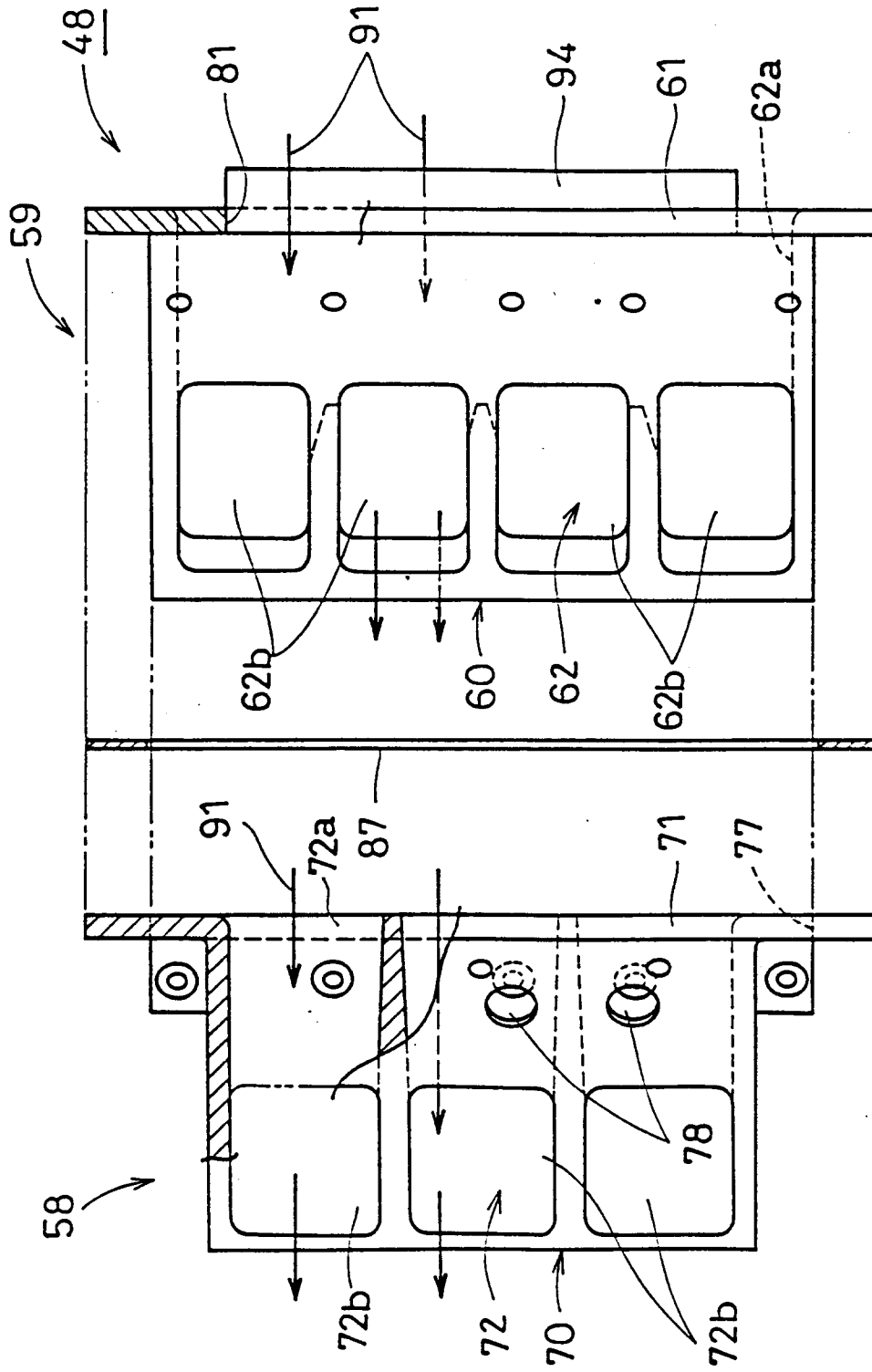


Fig. 6

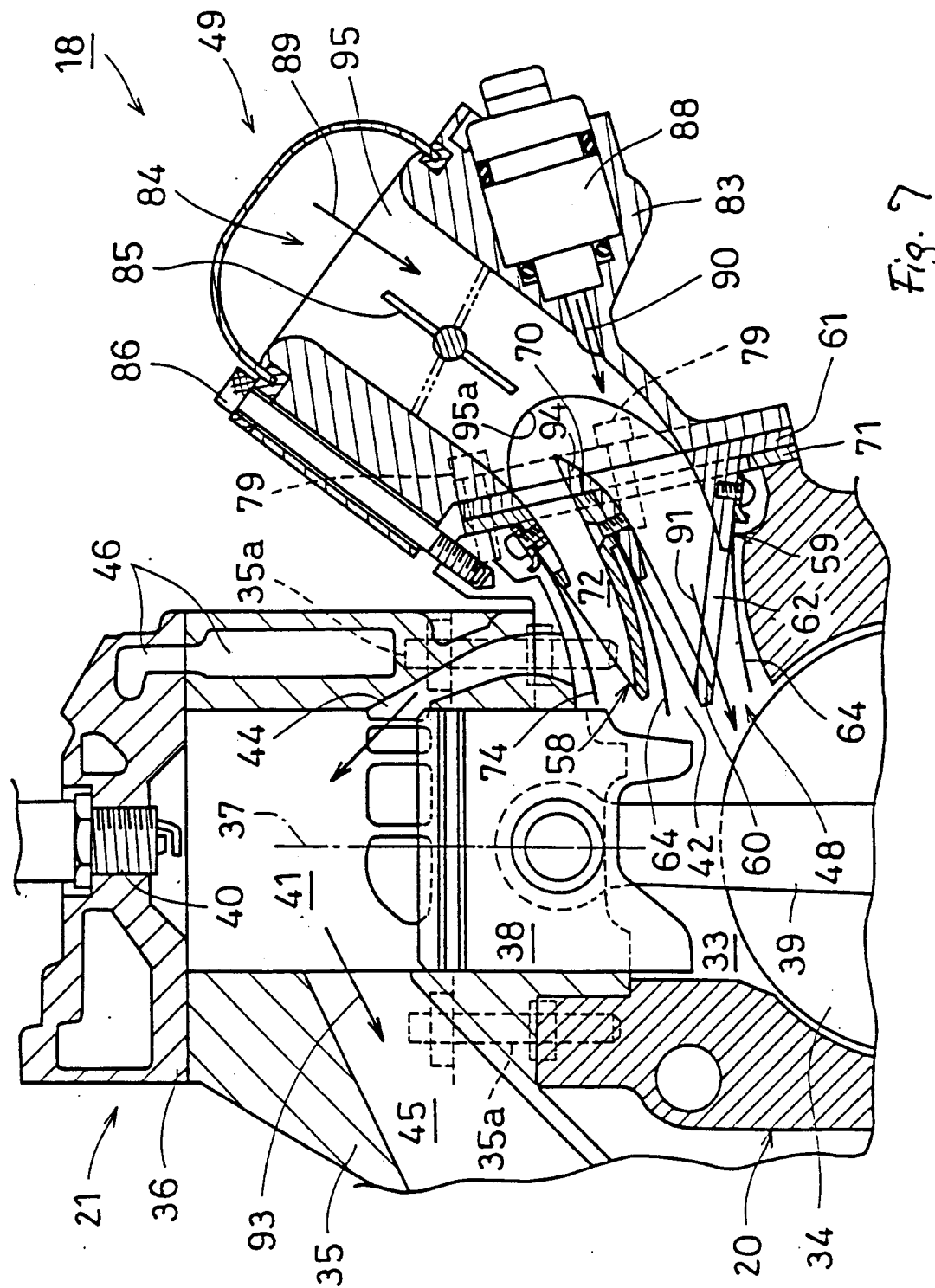
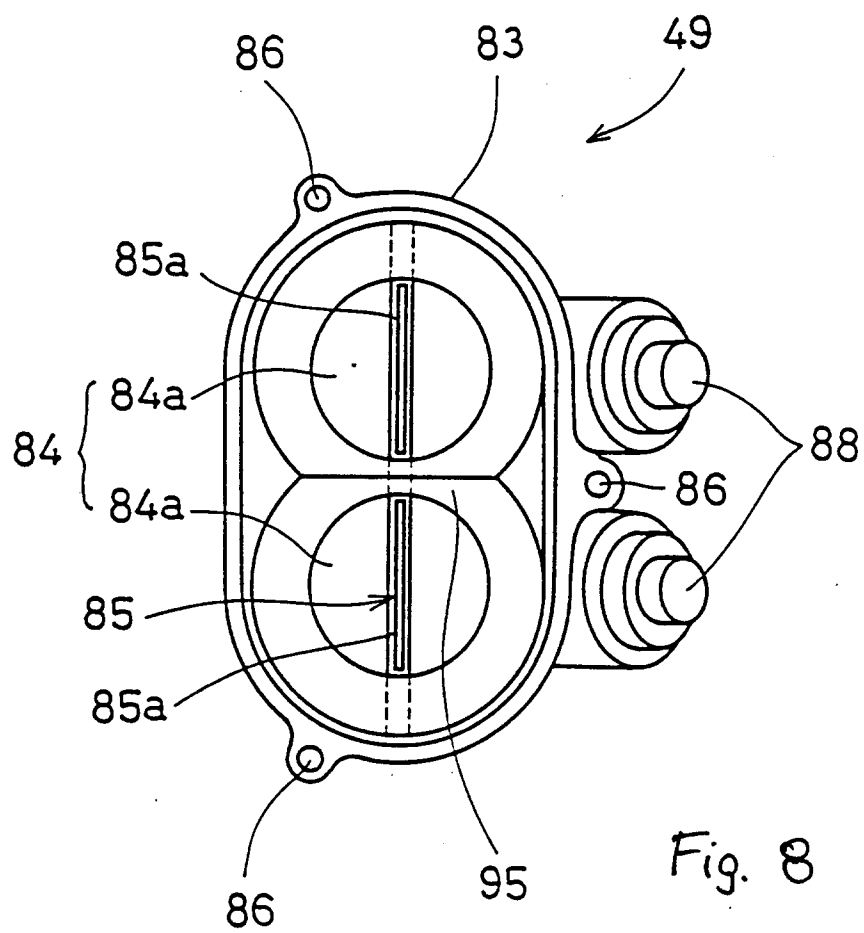


Fig. 7



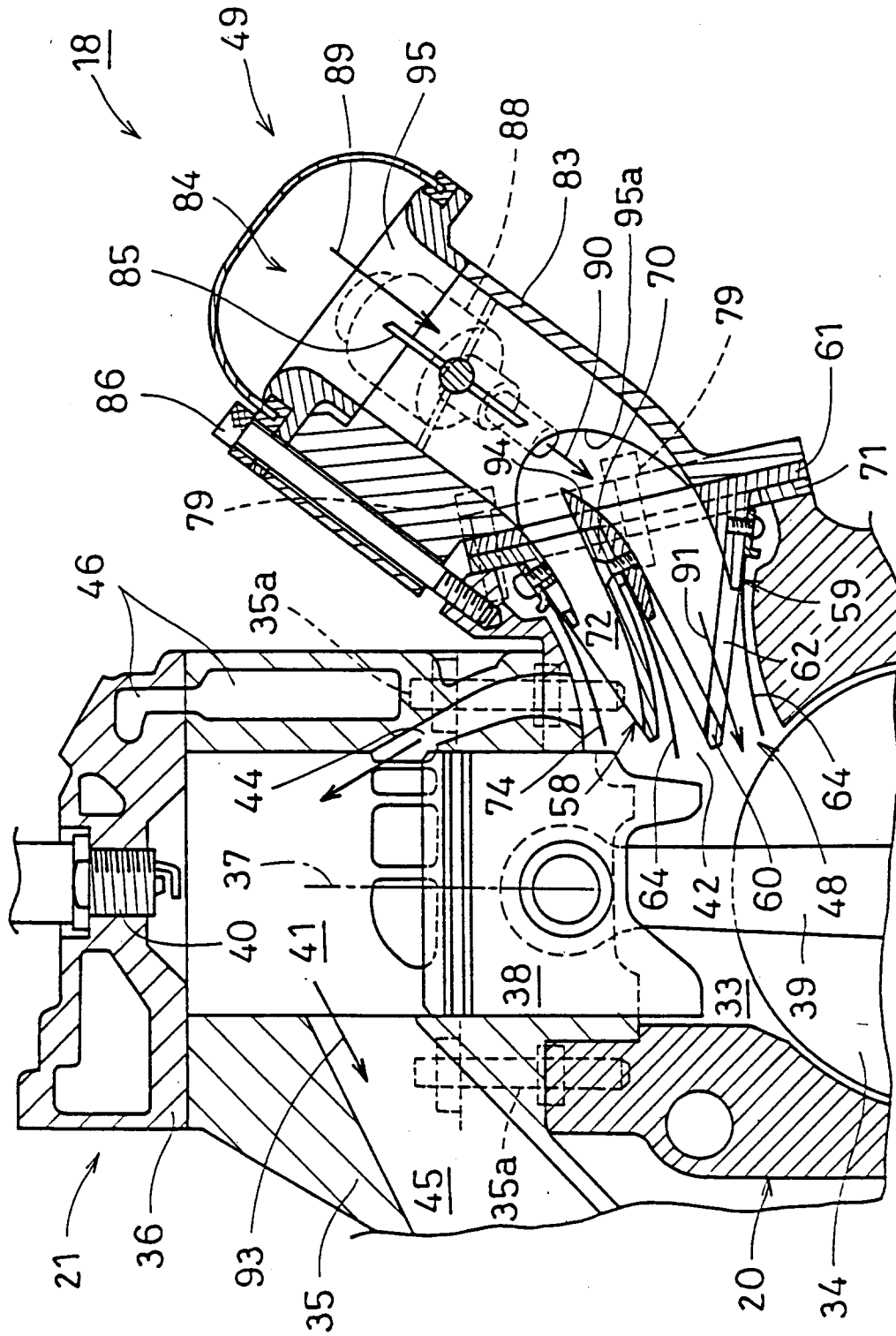


Fig. 9

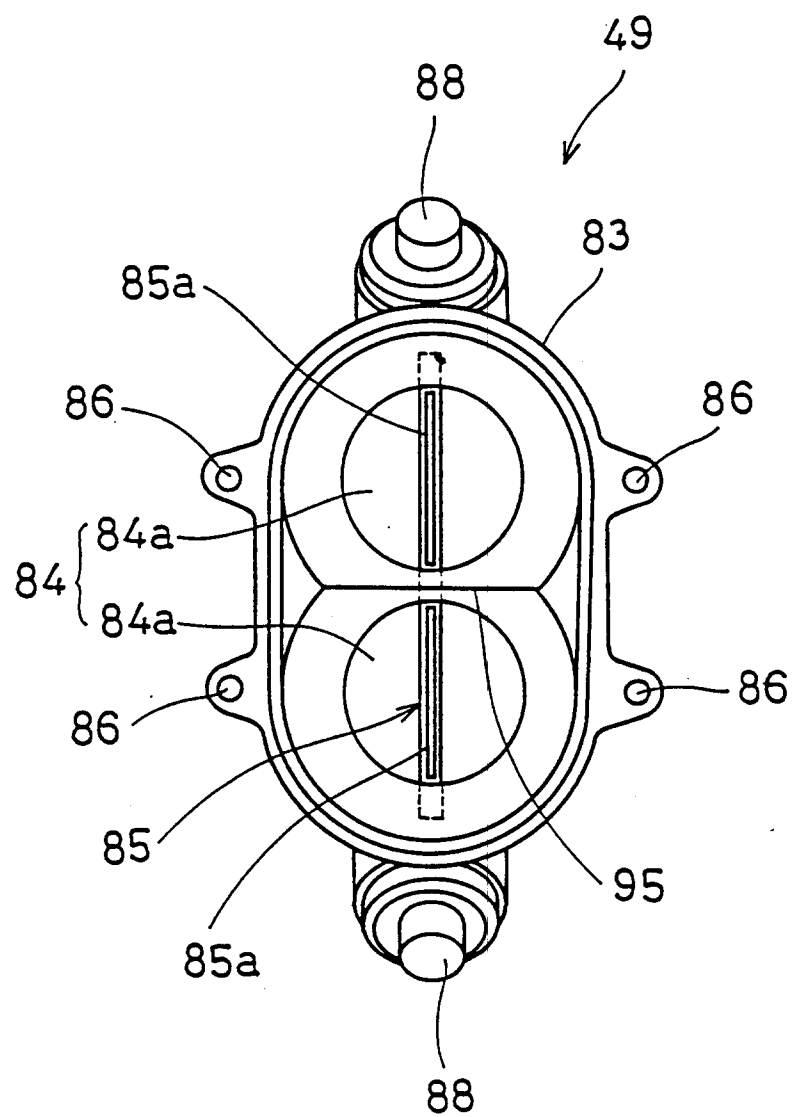


Fig. 10

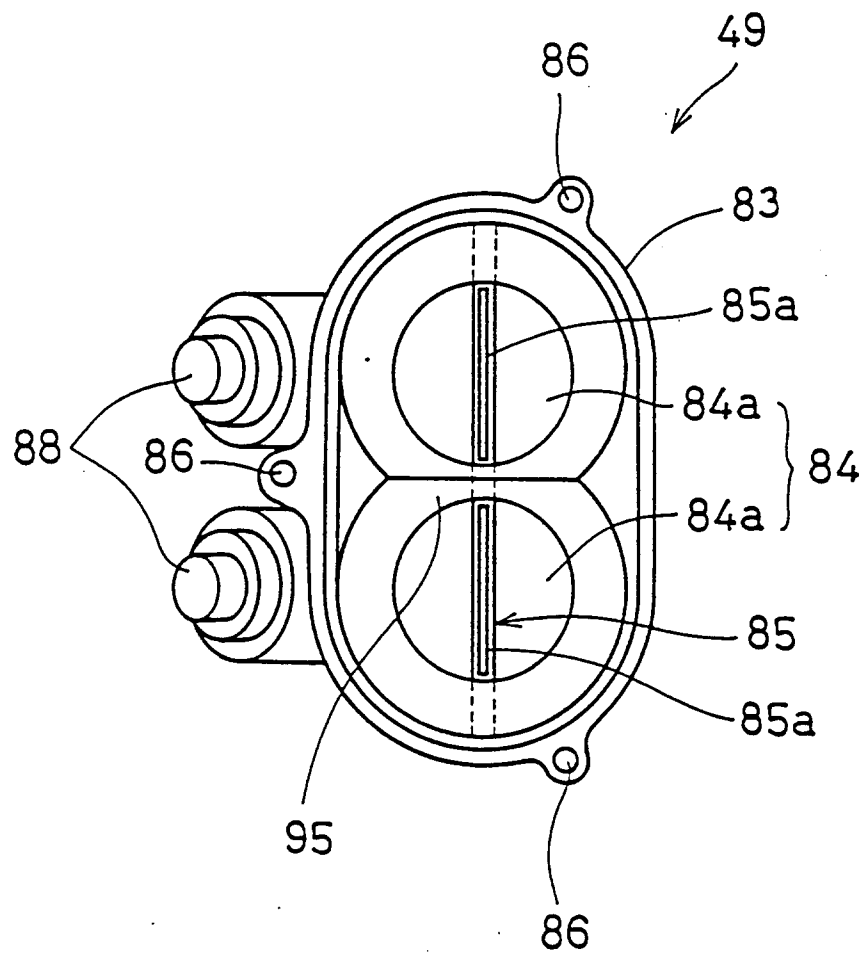
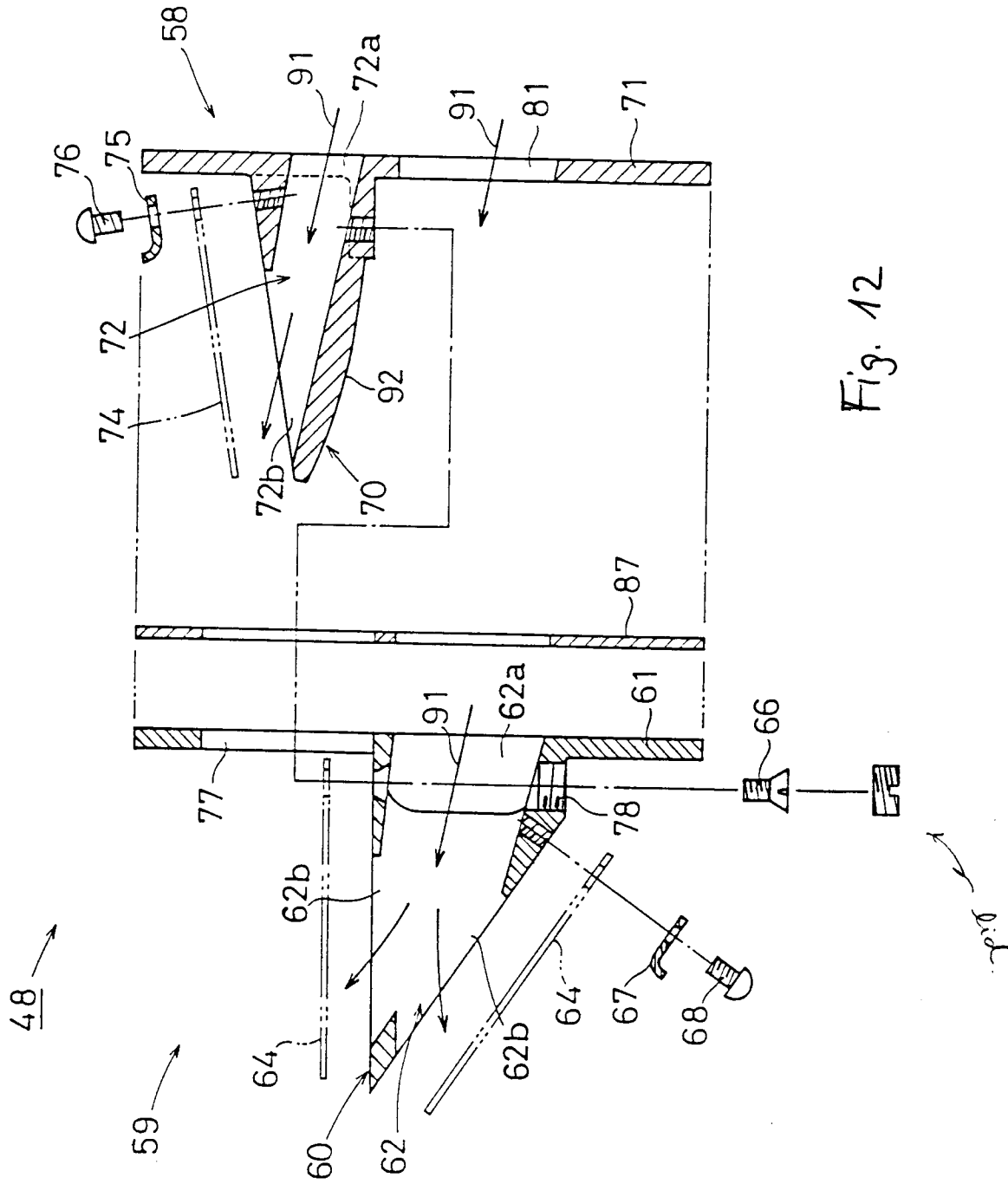


Fig. 11



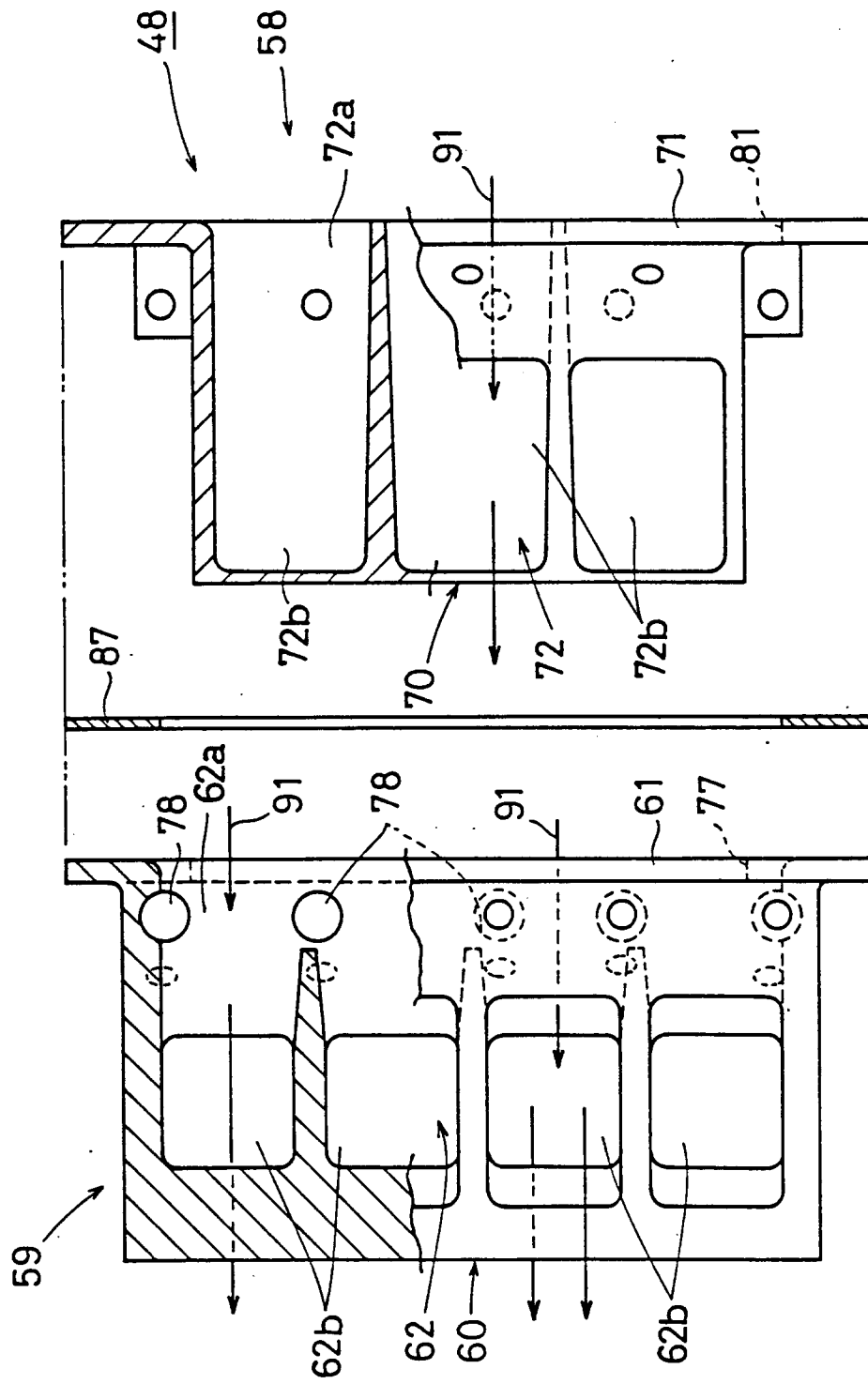


Fig. 13



European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 92 12 2063

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 119 (M-1225)25 March 1992 & JP-A-32 86 139 (SUZUKI) 17 December 1991 * abstract *	1	F01L3/20
A	EP-A-0 337 520 (ALFA LANCIA) * column 3, line 33 - line 37 * * column 5, line 1 - line 3 * * figures 1-4 *	2-4	
A	US-A-4 395 978 (BOYESEN) * column 3, line 58 - line 62 * * column 4, line 52 - line 68 * * figures 1,2 *	1,2	
A	US-A-3 008 459 (KAUFMAN) * column 2, line 19 - line 21 * * column 3, line 8 - line 30 * * figures 1,2 *	1,2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F01L F02B F16K
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 MARCH 1993	Examiner LEFEBVRE L.J.F.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			