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(54) Multi-flow type sub cool condenser

(57) A multi-flow type sub cool condenser (1000) comprises a first header pipe (1), having at one end a plugging mechanism (100, 200, 300, 400) in which a plugging member can be fastened or unfastened at will manually and which enables a desiccant (13), having a length comparable to that of said first header pipe, to be put in and taken out of said first header pipe. A second header pipe (2), the interior of which is sectioned into two chambers (2a,2b) by a partition plate (8). A plurality of flat heat transfer tubes (4) interconnect said first and second header pipes, and a plurality of corrugated fins (5) are interposed between said flat tubes (4).

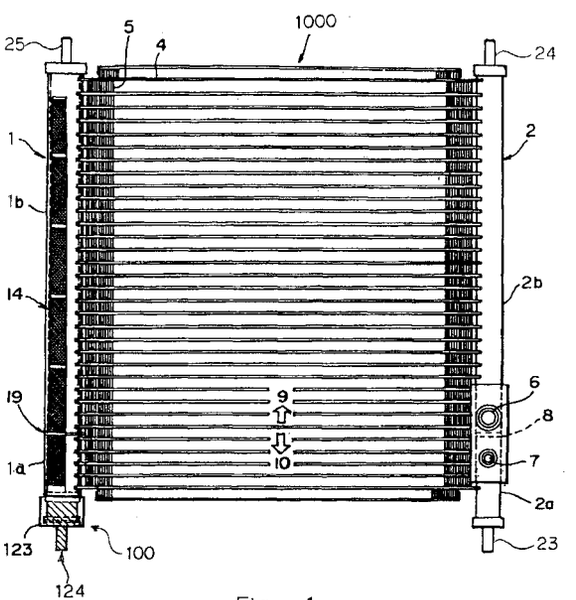

Fig. 1

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Description

[0001] The present invention relates to a multi-flow type sub cool condenser used as a condenser in a vehicular air conditioning apparatus. More particularly, this invention relates to a multi-flow type sub cool condenser whose header pipe includes a desiccant.

[0002] A multi-flow type sub cool condenser is often used in a vehicular air conditioning apparatus. Specifically, the so-called sub cool condenser generally has a portion for heat exchange called the sub cool portion that cools further the liquefied refrigerant. Before flowing into the sub cool portion, the liquefied refrigerant must be accumulated somewhere. The vessel for accumulating the liquefied refrigerant before sub-cooling is called the liquid tank. In Japanese Patent Publication Hei 10-122705, Hei 9-170854 and Hei 9-170853, the liquid tank is disposed next to a header pipe of the condenser. This conventional structure is disadvantageous because as the condenser and the liquid tank are separate from each other, their sizes are limited due to the constraint on the volume that a refrigeration circuit can occupy in a vehicle.

[0003] The refrigerant that has been liquefied in the condenser is then passed through a drier including desiccant for removal of water content. As disclosed in Japanese Patent Publication Hei 3-241273 and Hei 9-48232, the drier vessel itself conventionally is also provided as a separate vessel from the condenser. So this conventional structure is also disadvantageous with respect to the volume of space occupied in the vehicle.

[0004] A structure in which the desiccant of the drier is included in a liquid tank in order to save space is disclosed in Japanese Patent Publication Hei 9-538G7, Hei 8-219590 and Hei 9-33139. However, since the liquid tanks even in this structure oppress the area of the heat exchange core, this does not fully resolve the problem.

[0005] Further, as to the desiccant, it needs a relatively frequent repair or exchange because of its temporal change in quality or deterioration.

[0006] Thus, it has been long desired to make a multi-flow type sub cool condenser that can simultaneously both resolve the above problems and meet the above requirements and allows conducting easy maintenance of the desiccant.

[0007] The first object of the present invention is to provide a multi-flow type condenser that is equipped with a sub cool core. For that purpose, the multi-flow type sub cool condenser according to the present invention is designed to have a header pipe of which the lower portion functions as a liquid tank.

[0008] The second object of the present invention is to provide a multi-flow type condenser that includes a desiccant. For that purpose, the multi-flow type sub cool condenser according to the present invention is designed to have a header pipe containing a desiccant and functioning as a drier vessel too.

[0009] The third object of the present invention is to provide a multi-flow type condenser that is equipped with a plugging mechanism at one end of the header pipe that allows easy repair of the desiccant. For that purpose, the multi-flow type sub cool condenser according to the present invention discloses four kinds of plugging mechanisms.

[0010] The first plugging mechanism comprises a bracket member that is fixed to the end of the header pipe and in which a female screw is provided, and plugging member around which a male screw is provided.

[0011] The second plugging mechanism comprises a block member which is fixed to the end of the header pipe and in which an internally bored groove is provided, and plugging member having protrusions that engage with the internally bored groove.

[0012] The third plugging mechanism comprises a block member that is fixed to the end of the header pipe and that has a couple of slits at diametrically opposing positions, a U-shaped stopper member that engages with the two slits and plugging member around which circumstance is provided a circular groove.

[0013] The fourth plugging mechanism comprises a flange member that is fixed to the end of the header pipe and that has a female screw member attached to its both sides, and plugging member that can be fixed to the flange member by screws.

[0014] Other objects, features, and advantages of this invention will be understood from the following description of preferred embodiments with reference to the drawings.

[0015] In the Drawings;

Fig. 1 is an elevational view of a multi-flow type sub cool condenser according to the first embodiment of the present invention.

Fig. 2 is a longitudinal cross sectional view of the left header pipe of Fig.L Fig. 3 is a magnified view showing a portion of the Structure of the container of the desiccant near the partition plate of Fig. 2.

Fig. 4 is a magnified view showing a portion of another structure of the container of the desiccant near the partition plate of Fig. 2.

Fig. 5 is a perspective view of the container of the desiccant of Fig. 2

Fig. 6 is a longitudinal cross sectional view of the left header pipe of Fig. containing another example of the container of the desiccant.

Fig. 7 is an axial cross sectional view of Fig. 6.

Fig. 8 is a longitudinal cross sectional view of the left header pipe of Fig.1 containing a yet another example of desiccant.

Fig. 9 is a perspective view of the desiccant of Fig. 8.

Fig. 10 is an elevational view of a multi-flow type sub cool condenser according to the second embodiment of the present invention.

Fig. 11 is a longitudinal cross sectional view of the left header pipe of Fig. 10.

Fig. 12 is a perspective view of the plugging mem-

ber used in the second embodiment of the present invention.

Fig. 13 is a longitudinal cross sectional view of the block member used in the second embodiment of the present invention.

Fig. 14 is a longitudinal cross sectional view of the plugging mechanism according to the second embodiment of the present invention.

Figs. 15(a)-15(c) are brief process charts of screwing on the plugging member according to the second embodiment of the present invention.

Fig. 16 is an elevational view of a variation of the plugging member.

Fig. 17 is a top plan view of the first header pipe according to a variation of the second embodiment of the present invention.

Fig. 18 is lateral view of Fig. 17.

Fig. 19 is a top plan view of the bracket member according to a variation of the second embodiment of the present invention.

Fig. 20 is a longitudinal cross sectional view of the bracket member of Fig. 19.

Fig. 21 is a lateral view of the plugging member according to a variation of the second embodiment of the present invention.

Fig. 22 is a bottom plan view of the plugging member of Fig. 21.

Figs. 23(a)-23(c) are brief process charts of screwing on the plugging member according to the variation of the second embodiment of the present invention. Fig. 24 is a top plan view of the first header pipe according to yet another variation of the second embodiment of the present invention.

Fig. 25 is a longitudinal cross sectional view of Fig. 24.

Fig. 26 is a top plan view of the plugging member according to the variation of the second embodiment of the present invention.

Fig. 27 is a lateral view of the plugging member of Fig. 26.

Fig. 28 is a longitudinal cross sectional view of the plugging mechanism according to the variation of the second embodiment of the present invention.

Fig. 29 is a lateral view of the plugging member according to yet another variation of the second embodiment of the present invention.

Fig. 30 is a top plan view of the plugging member of Fig. 29.

Fig. 31 is a lateral view of the block member according to the variation of the second embodiment of the present invention.

Fig. 32 is an elevational view of the block member of Fig. 31. Fig. 33 is a top plan view of the block member of Fig. 31.

Fig. 34 is a longitudinal cross sectional view of the plugging mechanism according to the variation of the second embodiment of the present invention.

Fig. 35(a)-35(c) are brief process charts of screwing on the plugging member according to the variation of the second embodiment of the present invention.

Fig. 36 is an elevational view of a multi-flow type sub cool condenser according to the third embodiment of the present invention.

Fig. 37 is a longitudinal cross sectional view of the plugging mechanism of Fig. 36.

Fig. 38 is an axial cross sectional view including the stopper member of Fig. 37.

Fig. 39 is an assembling chart of the plugging mechanism of Fig. 36. Figs. 40(a)-40(b) are brief process charts of fixing the stopper member according to a variation of the third embodiment of the present invention.

Fig. 41(a)-41(b) are brief process charts of fixing the stopper member according to yet another variation of the third embodiment of the present invention.

Fig. 42 is a lateral view of the plugging mechanism according to yet another variation of the third embodiment of the present invention.

Fig. 43(a)-43(c) are brief process charts of fixing the stopper member according to the variation of the third embodiment of the present invention.

Fig. 44 is a longitudinal cross sectional view of the plugging mechanism according to yet another variation of the third embodiment of the present invention. Fig. 45 is an axial cross sectional view of Fig. 44 including the stopper member. Fig. 46 is an elevational view of a multi-flow type sub cool condenser according to the fourth embodiment of the present invention.

Fig. 47 is a longitudinal cross sectional view of the left header pipe of Fig. 46.

Fig. 48 is a longitudinal cross sectional view of the upper portion of the left header pipe of Fig. 46.

Fig. 49 is a top plan view of the left header pipe of Fig. 46.

Fig. 50 is a longitudinal cross sectional view of the plugging mechanism according to a variation of the fourth embodiment of the present invention.

Fig. 51 is a longitudinal cross sectional view of the plugging mechanism according to a yet another variation of the fourth embodiment of the present invention.

Fig. 52 is a top plan view of the plugging mechanism according to the variation of the fourth embodiment of the present invention.

[0016] In Fig. 1, a multi-flow type sub cool condenser according to the first embodiment of the present invention is shown. Hereafter, a multi-flow type sub cool condenser will be called simply a condenser, for simplicity. The condenser 1000 comprises mainly the first header pipe 1, the second header pipe 2, a plurality of flat heat transfer tubes 4 and a plurality of corrugate fins 5. The first header pipe 1 and the second header pipe 2 are interconnected via the plurality of heat transfer tubes 4. The plurality of heat transfer tubes4 and the plurality of

corrugated fins 5 are stacked alternately. The first header pipe 1 is sectioned into upper pipe portion lb and lower pipe portion la by a partition plate 19. The second header pipe 2 is sectioned into upper pipe portion 2b and lower pipe portion 2a by a partition plate 8. To the second header pipe 2, an inlet pipe 6 is connected above and near the partition plate 8. The refrigerant flows into the upper pipe portion 2b of the second header pipe 2 via the inlet pipe 6 from an external refrigeration circuit (not shown). To the second header pipe, an outlet pipe 7 is further connected below and near the partition plate 8. The refrigerant flows out from the lower pipe portion 2a of the second header pipe 2 via the outlet pipe 1 to the external refrigeration circuit (not shown). The upper portion of the condenser 1000 sectioned by the two partition plates 19 and 8 is called a refrigerant condensing core 9 in this specification. The lower portion of the condenser 1000 sectioned by the two partition plates 19 and 8 is called a sub cool core 10 in this specification. That is, the refrigerant condensing core 9 comprises the upper pipe portion 2b of the second pipe header 2 and the upper pipe portion lb of the first header pipe 1 and the portion of the plurality of the heat transfer tubes 4 that interconnect them. The sub cool core 10 comprises the lower pipe portion 2a of the second pipe header 2 and the lower pipe portion 1a of the first header pipe 1 and the remaining portion of the plurality of the heat transfer tubes 4 that interconnect them.

[0017] The refrigerant condensing core 9 functions to condensate and liquefy the refrigerant. The refrigerant flows from the upper pipe portion 2b of the second header pipe 2 to the upper pipe portion 1b of the first header pipe 1 via the heat transfer tubes 4 that belong to the refrigerant condensing core 9. The refrigerant flowing into the upper pipe portion 1b of the first header pipe 1 is liquefied and accumulates in the lower pipe portion 1a of the first header pipe 1. The sub cool core 10 functions to further cool the liquefied refrigerant. That is, the liquefied refrigerant flows from the lower pipe portion 1a of the first header pipe 1 to the lower pipe portion 2a of the second header pipe 2 via the remaining heat transfer tubes 4 that belong to the sub cool core 10, thereby being further cooled.

[0018] To the upper end of the first header pipe 1 a bracket 25 is fixedly brazed to hermetically seal off the header pipe 1. To the upper and lower ends of the second header pipe 2, two brackets 23 and 24 are fixedly brazed to hermetically seal off the header pipe 2. To the lower end of the first header pipe 1 a plugging mechanism 100 according to the first embodiment of the present invention is provided. The plugging mechanism 100 that can be fastened and unfastened at will comprises a bracket member 123 that is fixedly brazed to the lower end of the first header pipe 1 and a plugging member 124 that is screwed into the bracket member 123.

[0019] With reference to Fig. 2, the partition plate 19 provided in the first header pipe 1 has a hole through which a container 14 containing a desiccant passes. The material constituting the container 14 can pass a fluid freely through its surface. In the container 14 a desiccant 13 is contained. The desiccant 13 may be shaped as one solid bar integrally by an adhesive or by a heat process as long as it can passes the refrigerant through its interior. Or the desiccant may be granular material contained in a fibrous bag. The container 14 comprises a skeleton 15 having cylindrical lattice and mesh portion 16. Or the container 14 may comprises a cylinder having punched wall.

[0020] The refrigerant having passed through the heat transfer tubes 4 of the refrigerant condensing core 9 flows into the interior of the upper pipe portion lb of the first header pipe 1 as indicated by arrow 12. The refrigerant flowing into the upper pipe portion lb further flows through the interior of the container 14 and the desiccant 13. Then the water content in the refrigerant is removed. Actually, the refrigerant having passed through the heat transfer tubes 4 of the refrigerant condensing core 9 is in a heavy mist state. The refrigerant in the mist state accumulates in the lower pipe portion la and lower portion of the upper pipe portion lb of the first header pipe 1. The surface of the accumulated liquid refrigerant is indicated by a numeral 17.

[0021] Specifically the interior of the lower pipe portion la of the first header pipe 1 is called as liquid refrigerant accumulating portion 11. in this specification.

[0022] The plugging member 124 comprises rod portion 124c, sealing portion 124b and male screw portion 124a. The rod portion 124c is used for fixing the condenser 1000 to a vehicular body by inserting it into a hole provided in a vehicular frame, Around the sealing portion 124b an O-ring 125 is fitted for hermetical sealing.

[0023] One end of the bracket member 123 is fixedly brazed on the lower end 1a1 of the first header pipe 1. On the interior wall of the bracket member 123 is provided a female screw. By screwing the plugging member 124 into the bracket member 123, the plugging mechanism 100 can fasten the plugging member 124. By screwing the plugging member 124 off the bracket member 123, the plugging mechanism 100 can unfasten the plugging member 124. In this way, the repair or the maintenance of the desiccant 13 can be done.

[0024] An upper surface of the male screw portion 124a of the plugging member 124 pushes an adaptor member 126 upwardly. An upper surface of the adaptor member 126 pushes the bottom skeleton 15a of the container 14 upwardly. Thus, the container 14 of the desiccant 13 as a whole is supported by the partition plate 19 and the adaptor member 126.

[0025] It is preferable to provide a gap 18 between the ends of the heat transfer tubes 4 that protrude into the interior of the first header pipe 1 and the surface of the container 14 of the desiccant 13.

[0026] With reference to Fig. 3, a detailed illustration of the supporting structure of the container 14 by the

partition plate 19 is depicted. To the container 14 a flange 21 is provided and it engages with the partition plate 19. A hole 20 limits the radial movement of the container 14, and the engagement of the flange 21 and the partition plate 19 limits the axial movement of the container 14.

[0027] With reference to Fig. 4, a detailed illustration of another supporting structure of the container 14 by the partition plate 19 is depicted. The container 14 comprises a thin diameter portion 14a and a thick diameter portion 14b. A shoulder portion between the thin diameter portion 14a and the thick diameter portion 14b engages with the partition plate 19. A hole 20 limits the radial movement of the container 14, and the engagement of the shoulder portion and the partition plate 19 limits the axial movement of the container 14.

[0028] In Fig. 5, a perspective view of the skeleton 15 of the container 14 is illustrated.

[0029] In Fig. 6, another way for providing a gap between the ends of the heat transfer tubes 4 that protrude into the interior of the first header pipe 1 and the surface of the container 14 of the desiccant 13, is illustrated. Fig. 7 is the axial cross sectional view of the Fig. 6. In Fig. 6 the cross sectional shape of the container 14 is circle. With reference to Fig. 7, the ends 4a of the heat transfer tubes 4 that protrude into the interior of the first header pipe 1 are cut along a similar curve to the axial cross sectional shape of the container 14. This cut line 4a provides the gap 18' so that the refrigerant coming from the heat tubes 4 can flow smoothly into the interior of the first header pipe 1 and the interior of the container 14.

[0030] In Fig. 8, the first header pipe 1 containing a desiccant 42 formed as one bar integrally by an adhesive is illustrated. In Fig. 9, the desiccant 42 is illustrated in a perspective view.

[0031] The cross section of the desiccant 42 integrally formed as one bar or the cross section of the container 14 of the desiccant may be circle, generally circle, oval, or half circle.

[0032] In Fig. 10, a condenser 1000 according to the second embodiment of the present invention is shown. To the same parts with the first embodiment, the same numerals are attached, and their explanations are omitted. A bracket 26 is fixedly brazed on the header pipe 1 like the other brackets 24 and 23.

[0033] On the upper end of the first header pipe 1, a plugging mechanism 200 according to the second embodiment of the present invention in which a plugging member can be fastened or unfastened at will is provided. The plugging mechanism 200 comprises a generally cylindrical block member 240 that is fixedly brazed to the upper end of the first header pipe 1 and a plugging member 243 that is screwed into the block member 240.

[0034] With reference to Fig. 11, the lower point of the container 14 is formed in a tapered form so as to make it easy to insert the container 14 through the hole 20 of the partition plate 19. The container 14 of the desiccant can be removed or inserted through a central hole 280 of the block member 240 that is fixed to an upper end 1b1 of the first header pipe 1. An adaptor member may be disposed to hold the upper end of the container 14 between the lower surface of the plugging member 243 and the upper end of the container 14. However, in practice, since the desiccant 13 itself and the container 14 are very light, the only engagement between the container 14 and the hole 20 of the partition plate 19 can support the container 14 and the desiccant 13 without using the extra adaptor member.

[0035] The structure of the plugging member 243 is as shown in Fig. 12. On the upper surface of the plugging member 243 a knob 247 may be provided so as to make it possible to screw manually the plugging member 243 into the block member 240 or to screw it off manually. At four places around the plugging member 243 rectangular projections 244 that protrude radially outwardly from the center are provided. In Fig. 13, a longitudinal cross sectional view of the block member 240 is shown. At about the center of the block member 240 a central hole 280 is bored. To the upper portion of the central hole 280 a tapered surface 291 is connected. And to the tapered surface 291 an internally bored groove 290 is connected. Finally to the internally bored groove 290 a opening 292 that is slightly wider than the diameter D of the plugging member 243 is connected. On a flange 241 of the opening 292 that projects inwardly, four rectangular notch 242 having such width as to accept the projections 244 of the plugging member 248 are provided. In the lower surface of the flange 241, recesses 248 that are concave toward the upper direction and are slightly wider than the projections 244 of the plugging member 243 are provided at places between the neighbouring two notches 242.

[0036] With reference to Fig. 14, a state in which the plugging member 243 has been screwed into the block member 240 is shown. By adjusting each projection 244 of the plugging member 243 to the corresponding notches 242 of the block member 240, the plugging member 243 can be manually inserted into the central hole 280 of the block member 240. 249 is an 0-ring for hermetical sealing fitted on the plugging member 243. Because the axial motion of the projections 244 of the plugging member 243 is limited by the flange 241 of the block member 240, the plugging member 243 will not be released spontaneously.

[0037] In Figs. 15(a)-15(c), a brief process charts for screwing the plugging member 243 into the block member 240 are shown. With reference to Fig. 15(a), first, the projections 244 of the plugging member 243 are adjusted to the corresponding notches 242 of the block member 240, and the plugging member 243 is manually inserted in a axial direction into the central hole 280 of the block member 240. With reference to Fig. 15(b), then, the plugging member 243 is rotated by about 45 degrees so as to turn the projections 244 within the internally bored groove 290. With reference to Fig. 15(c), last, by pulling the plugging member 243 to the axially

outward direction, it is possible to make the projections 244 of the plugging member 243 engage with the internal recesses 248 on the flange 241 of the block member 240. By the engagement of the projections 244 and the recesses 248, both of axial movement and rotational movement of the plugging member 243 is limited.

[0038] By doing the processes shown in Fig. 15(a)-15 (c) in a reversed order, it is possible to remove easily the plugging member 243 from the block member 240. Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0039] Though the plugging member 243 has projections which have rectangular cross section as shown in Fig. 12, the cross section of the projections may have other shape. An example is shown in Fig. 16. At four places around a plugging member 245 shown in Fig. 16, cylindrical shaped pins 246 are implanted. Of course the plugging member 245 together with the cylindrical pins 240 may be formed integrally.

[0040] In Figs. 17-23(c), a plugging mechanism 200 according to a variation of the second embodiment of the present invention in which a plugging member can be fastened or unfastened at will is shown. With reference to Figs. 17-18, from the edge of the upper end 1b1 of the first header pipe 1, a couple of rectangular cut out portions 250 are provided at diametrically opposing positions.

[0041] With reference to Figs. 19-20, a bracket member 251 has a short cylindrical shape. On the inner wall of the bracket member 251 an inwardly pointing flange 253 is provided. The flange 253 is divided into two portions by a pair of rectangular notches 252 provided at diametrically opposing positions.

[0042] With reference to Figs. 21-22. a plugging member 254 has a pair of projections 255 protruding diametrically outwardly.

[0043] With reference to Fig. 18 and Fig. 20, a plugging mechanism 200 according to a variation of the second embodiment of the present invention is assembled by fixing and brazing the bracket member 251 onto the upper end 1b1 of the first header pipe 1 after adjusting a side of the notch 252 of the bracket member 251 to a side of the cut out portion 250 of the upper end 1b1 of the first header pipe 1. Then, with reference to Fig. 23 (a), by adjusting the projections 255 of the plugging member 254 to the notches 252 of the bracket member 251, it is possible to insert in the axial direction the plugging member 254 into the bracket member 251. Fig. 23 (b) shows a state in which the plugging member 254 has been inserted into the bracket member 251.

[0044] The cut out portions 250 of the upper end 1b1 of the first header pipe I. and the flange 253 of the bracket member 251 cooperatively define two grooves in which the projections 255 of the plugging member 254 can turn around by a certain angle. Thus, by rotating the plugging member 254 from a state of Fig. 23(b) to a state of Fig. 23(c), it is possible to bring the plugging member in a state in which the plugging member 254 can not be pulled out in an axial direction.

[0045] By doing the processes shown in Fig. 23(a)-23 (c) in a reversed order, it is possible to remove easily the plugging member 254 from the bracket member 251. Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0046] In Figs. 24-28, a plugging mechanism 200 according to a yet another variation of the second embodiment of the present invention in which a plugging member can be fastened or unfastened at will is shown. With reference to Figs. 24-25, in the upper end 1b1 of the first header pipe 1, an expanded portion 257 is provided. The lower portion of the expanded portion 257 is a circular shoulder portion 257b, and. upper portion of the expanded portion 257 is a inwardly pointing flange 257a. In the flange 257a, four rectangular notches 256 are provided.

[0047] With reference to Fig. 26-27, around the plugging member 258, four projections 259 protruding outwardly are provided at diametrically opposing positions.

[0048] With reference to Fig. 24 and Fig. 26, the plugging mechanism 200 enables the plugging member 258 to be inserted in a axial direction into the expanded portion 257 provided in the upper end 1b1 of the first header pipe 1 after adjusting the projections 259 of the plugging member 258 to the notches 256 of the flange 257a.

[0049] The expanded portion 257 of the upper end 1b1 of the first header pipe 1 forms by itself an internal circular groove in which the projections 259 of the plugging member 258 can orbit. Therefore, if after inserted into the flange 257a the plugging member 258 is rotated by a certain angle, then the plugging member 258 becomes in a state in which the plugging member 258 can not be released spontaneously because of the engagement of the projections 259 and the circular shoulder portion 257b and the flange 257a. This state is shown in Fig. 28.

[0050] By doing the processes in a reversed order, it is possible to remove easily the plugging member 258 from the expanded portion 257. Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0051] In Figs. 29-35(c), a plugging mechanism 200 according to a yet another variation of the second embodiment of the present invention in which a plugging member can be fastened or unfastened at will is shown. With reference to Figs. 29-30, to a plugging member 264 two wide projections 265 projecting outwardly are provided at diametrically opposing positions. And for easy manual handling a knob 260 is provided on the plugging member 264. At a lower portion of the plugging member 264 is fitted an 0-ring 249 for hermetical sealing.

[0052] With reference to Figs. 31-33, a block member 261 comprises a lower short cylindrical portion and an upper portion having hooking function. With reference to Fig, 32, in the upper portion of the block member 261, a pair of arms 263 that protrude toward the center are provided. At middle portion between the upper arm portion 263 and the short cylindrical portion of the block

member 261 is provided a plate portion 262. In the plate portion 262, a female screw 266 is provided.

[0053] With reference to Fig. 34, a plugging mechanism 200 according to this variation of the second embodiment of the present invention is assembled first by inserting the lower short cylindrical portion into the upper end 1b1 of the first header pipe 1 and fixing and brazing them. With reference to Fig. 35(a), then, by adjusting the angular position of the plugging member 264 relative to the arms 263 such that the projections 265 are not hindered by the arms 263, it is possible to insert the plugging member 264 into the block member 261.

[0054] Under the arms 263 themselves, grooves in which the projections 265 of the plugging member can orbit by a certain angle are formed. Therefore, by rotating the plugging member 264 from a state shown in Fig. 35(b) to a state shown in Fig. 35(c), it becomes into a state in which the axial movement of the plugging member 264 is limited by the arms 263.

[0055] By doing the processes shown in Fig. 35(a)-35 (c) in a reversed order, it is possible to remove easily the plugging member 264 from the block member 261.

[0056] Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0057] If a bolt 267 is screwed into the female screw 266, then the plugging member 264 becomes more securely fixed as shown in Fig. 34.

[0058] In Fig. 36, a condenser 1000 according to the third embodiment of the present invention is shown. To the same parts with the first embodiment, the same numerals are attached, and their explanations are omitted.

[0059] On the lower end of the first header pipe 1, a plugging mechanism 300 according to the third embodiment of the present invention in which a plugging member can be fastened or unfastened at will is provided. The plugging mechanism 300 comprises a generally cylindrical block member 320 that is fixed and brazed to the lower end of the first header pipe 1 and a plugging member 325 that is inserted straightly into the block member 320 and a stopper member 327.

[0060] In Fig. 37, a longitudinal cross sectional view of the plugging mechanism 300 in which the plugging member is in a fixed state is shown. The block member 320 is inserted and brazed to the lower end 1a1 of the first header pipe 1. The center hole 280 partially accommodates the bottom 14b of the container 14 of the desiccant. On the upper portion of the plugging member 325 an 0-ring 328 is fitted for hermetical sealing.

[0061] With reference to Fig. 39, the stopper member 327 is a U-shaped metal. The stopper member 327 has lateral side surfaces 327a and. 327b. On the outer surface of the block member 320, a pair of slits 324 in which the arms of the stopper member 327 are inserted, are provided at diametrically opposing positions. The slits 324 is in communication with the center hole 280 via rectangular hole 324c. The slit 324 has side surfaces 324a and 324b that are perpendicular to the axis of the first header pipe 1.

[0062] With reference to Fig. 39, first, the plugging member 325 is inserted into the center hole 280 of the block member 320 until a surface 326b of a circular groove 326 provided on the plugging member 325 coincide with the side surface 324b of the slit 324 of the block member 320. Then, two arms of the stopper member 327 is inserted into the two slits 324 of the block member 320. On this occasion, the lateral side surface 327a and 327b of the stopper member 327 engage with the side surfaces 324a and 324b of the slits 324. Therefore the stopper member 327 is fixed relative to the block member 320.

[0063] With reference to Fig. 38 further, on this occasion, a surface 326a of the circular groove 326 of the plugging member 325 extends beyond a straight bottom surface 324c of the slit 324. Therefore, the plugging member 325, due to the engagements between the surfaces 326a, 326b of the circular groove 326 of the plugging member 325 and the lateral side surfaces 327a, 327b of the stopper member 327 respectively, is fixed to the stopper member 327. As a result, the plugging member 325 can be fixed relative to the block member 320.

[0064] If we pull out the stopper member 327, then the fix of the plugging member is released and the plugging member 325 can be easily pulled out from the block member 320. Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0065] In Figs. 40(a)-41(b), a variation of the third embodiment of the present invention is shown. With reference to Figs. 40(a)-40(b), the stopper member 330 has longer arms. After inserting the arms of the stopper member 330 into the slits 324 of the block member 320, the points of the arms 332 of the stopper member 330 that protrude out of the block member 320 can be folded so as to embrace the block member 320. By this contrivance, the occurrence of a spontaneous release of the stopper member 380 can be prevented. Of course, it is possible to fold the points 332 of the arms back to its original shape, so the stopper member 330 can be easily fixed and easily detached.

[0066] With reference to Figs. 41(a)-41(b), one arm 334 of the stopper member 333 is designed to be longer than the other arm 336. After inserting the stopper member 333 into the slits 324, the point of the longer arm 334 of the stopper member 333 that protrudes out of the block member 320 may be bent by a right angle to embrace the block member 320. By bending the longer arm once, a folded portion 335 is formed, and by bending the point of the folded portion 335 further, the folded portion 337 is formed. The folded portion 337 is engaged with the tip of the shorter ann 336. By this contrivance, the occurrence of a spontaneous release of the stopper member 333 can be prevented. Of course, it is possible to fold the arm 334 back to its original shape, so the stopper member 333 can be easily fixed and easily detached.

[0067] In Figs. 42-43(b), another variation of the third

embodiment of the present invention is shown. With reference to Fig. 43(a), both the arms of the stopper member 338 are designed to be long. On each tip of the arms is provided a hole 343a for passing a bolt and female screw 343b respectively. In a terminal end of a side plate 16, a pair of ear portion 340 having holes 342 for passing the bolt are provided. After inserting the stopper member 338 into the slits 324 of the block member 320, the hole 343a and the female screw 343b of the stopper member 338 and the holes 342 are adjusted. Then, a bolt 341 is screwed into them. By this contrivance, the occurrence of a spontaneous release of the stopper member 338 can be prevented.

[0068] In Figs. 44-45, another variation of the third embodiment of the present invention is shown. Like before, the stopper member 346 is fixed to the block member 347 by the engagement of the stopper member 346 and the slits 348 of the block member 347. The lower surface 344b of the plugging member 344 is in engagement with one lateral side surface 346b of the stopper member 346. In a usual state of a refrigerant circuit, since the pressure in the first header pipe 1 is higher than the external atmosphere, this single sided engagement suffices.

[0069] In Fig. 46, a condenser 1000 according to the fourth embodiment of the present invention is shown. To the same parts with the first embodiment, the same numerals are attached, and their explanations are omitted.

[0070] On the upper end of the first header pipe 1, a plugging mechanism 400 according to the fourth embodiment of the present invention in which a plugging member can be fastened or unfastened at will is provided. The plugging mechanism 400 comprises a generally cylindrical flange member 426 that is fixed and brazed to the upper end of the first header pipe 1 and a plugging member 421 that is inserted straightly into the flange member 426 and fixed by bolts 431.

[0071] In Figs. 47-49, detailed state of the plugging mechanism 400 in which the plugging member 421 is fixed is shown. With reference to Fig. 48, to the center of the flange member 426 a short cylindrical portion 427 is provided. It is fixed and brazed to the upper end 1b1 of the first header pipe 1. On flanges 428 that are positioned at both sides of the short cylindrical portion 427, holes 429 for fixing female screw member 430 are provided. The female screw member 430 may be fixed to the hole 429 by pressure insertion or welding.

[0072] Lower portion of the plugging member 421 is inserted into the cylindrical portion 427 of the flange member 426. The lower portion of the plugging member 421 may be fitted an 0-ring 484 for hermetical sealing. To the both side of the plugging member 421 are provided flanges 421b that overlap the flange 428 of the flange member 426. In the both flange 421b, holes 432 for passing bolt are bored. By screwing a couple of bolts 431 into the female screw member 430 of the flange member 426 via the holes 432 of the plugging member 421, the plugging member 421 can be fixed onto the flange member 426. By screwing the bolts 431 off the female screw member 430, the plugging member 421 can be removed from the flange member 426. Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0073] In Fig. 50, a variation of the fourth embodiment of the present invention is shown. With reference to Fig. 50, at the meddle portion of the female screw member 430, an expanded portion 435 that functions to limit the insertion length of the female screw member 430 into to flange 428 is provided.

[0074] In Fig. 51-52, a yet another variation of the fourth embodiment of the present invention. In this variation, both of the flange member 440 and the plugging member 437 are asymmetrical. In the left side in Figs. 51-52, the flange member 440 has an overhanged flange 438 and a shoulder 436 that are made by folding twice the originally flat flange. And to the left side of the plugging member 437, a short flange 437a that can be inserted into between the flange 438 and the shoulder 436 is provided. The right side of the flange member 440, a portion 439 for providing a female screw 441 is made by folding twice and squashing the originally flat flange plate. To the right side of the plugging member 437 is provided a flange 437b having a hole for passing a bolt like before. By engaging the short flange 437a into the overhanged flange 438 and by screwing one bolt 431 into the female screw 441 via the flange 437b, the plugging member 437 can be fixed to the flange member 440. By screwing the bolt 431 off the female screw 441, the plugging member 437 can be detached from the flange member 440. Thus, it is possible to repair or exchange the desiccant in the first header pipe 1.

[0075] Thus, it is possible to put or to pull the desiccant in and out of the first header pipe by opening or closing the plugging mechanism in which a plugging member can be fastened and unfastened at will. And as has been clearly described already, since the condenser contains the desiccant in its one header pipe, it does not need an extra space for placing the separate receiver-drier vessel. Further the condenser does not suffer from a reduction in its heat exchange core area.

[0076] Although the present invention has been described in detail in connection with preferred embodiments, the invention is not limited thereto. It will be understood by those skilled in the art that variations and modifications may be made within the scope of this invention, as defined by the following claims.

Claims

1. A multi-flow type sub cool condenser (1000) comprising

   a first header pipe (1), having at one end a plugging mechanism (100, 200, 300, 400) in which a plugging member can be fastened or unfas-

tened at will manually and which enables a desiccant (13), having a length comparable to that of said first header pipe, to be put in and taken out of said first header pipe,
a second header pipe (2), the interior of which is sectioned into two chambers (2a,2b) by a partition plate (8),
a plurality of flat heat transfer tubes (4) interconnecting said first and second header pipes, and
a plurality of corrugated fins (5) interposed between said flat tubes (4).

2. A multi-flow type sub cool condenser (1000) of claim 1, wherein said desiccant (13) is contained in a container (14).

3. A multi-flow type sub cool condenser (1000) of claim 2, wherein said container (14) has a skeleton (15) and mesh portion (16).

4. A multi-flow type sub cool condenser (1000) of claim 2, wherein said container (14) is made from a punched plate.

5. A multi-flow type sub cool condenser (1000) of claim 1, wherein said desiccant (13) is first contained in a fibrous bag and then is contained in a container (14).

6. A multi-flow type sub cool condenser (1000) of claim 1, wherein said desiccant (13) is formed as one body integrally by a heat process or by an adhesive, and is then contained in a container (14).

7. A multi-flow type sub cool condenser (1000) of claim 1, wherein said desiccant (13) is formed as one body integrally by a heat process or by an adhesive, and then contained in said first header pipe (1).

8. A multi-flow type sub cool condenser (1000) of claim 1, wherein between said desiccant (13) and tips of said heat transfer tubes (4), a gap (18) is provided.

9. A multi-flow type sub cool condenser (1000) of claim 1, wherein tips of said heat transfer tubes (4) are cut so as to provide a warped gap (18') between said desiccant (13) and them.

10. A multi-flow type sub cool condenser (1000) of claim 1 or 2, wherein in said first header pipe (1) a partition plate (19) is provided to section said first header pipe into an upper pipe portion (1b) and a lower pipe portion (1a), and said desiccant (13) or said container (14) penetrates through a hole (20) provided in said partition plate (19).

11. A multi-flow type sub cool condenser (1000) of claim 2, wherein in said first header pipe (1) a partition plate (19) is provided to section said first header pipe into upper pipe portion (1b) and lower pipe portion (1a), and said container (14) of said desiccant (13) penetrates through a hole (20) provided in said partition plate (19), and said container (14) has at its middle portion a flange (21) that engages with said partition plate (19).

12. A multi-flow type sub cool condenser (1000) of claim 2, wherein in said first header pipe (1) a partition plate (19) is provided to section said first header pipe into upper pipe portion (ib) and lower pipe portion (la), and said container (14) of said desiccant (13) penetrates through a hole (20) provided in said partition plate (19), and said container (14) comprises a thin diameter portion (14a) and a thick diameter portion (14b), and a shoulder portion between them engages with said partition plate (19).

13. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (100) comprises a bracket member (123) that is brazed to an end of said first header pipe (1) and having on its interior wall a female screw, a plugging member (124) having on its outer surface a male screw, wherein said plugging member (124) can be screwed into and off said bracket member (123) thereby enabling said desiccant (13) to be exchanged.

14. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (200) comprises a block member (240) that is brazed to an end of said first header pipe (1) and having a center hole (280) and an internally bored groove (290) and notches (242), a plugging member (243) having on its outer surface a plurality of rectangular projections (244) that can be inserted into said notches (242) and orbited within said internally bored groove (290), wherein said plugging member (243) can be screwed into and off said block member (240), thereby enabling said desiccant (13) to be exchanged.

15. A multi-flow type sub cool condenser (1000) of claim 14, wherein instead of rectangular projections said plugging member (245) has a plurality of cylindrical shaped pins (246) made as separate parts.

16. A multi-flow type sub cool condenser (1000) of claim 14 wherein instead of rectangular projections said plugging member (245) has a plurality of cylindrical shaped pins (246) are made integrally with said plugging member.

17. A multi-flow type sub cool condenser (1000) of

claim 1, wherein said plugging mechanism (200) comprises an end of said first header pipe (1) from which a pair of rectangular portions (250) are cut out, a bracket member (251) that is brazed to an end of said first header pipe (1) and having an inwardly pointing flange (253) and a couple of notches (252) and, a plugging member (254) having on its outer surface a plurality of rectangular projections (255) that can be inserted into said notches (252) and orbited within said cut out portions (250) of said end of said first header pipe (1), wherein said plugging member (254) can be screwed into and off said bracket member (251), thereby enabling said desiccant (13) to be exchanged.

18. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (200) comprises an expanded portion (257) of said first header pipe (1) to which a plurality of rectangular notches (256) are provided, and a plugging member (258) having on its outer surface a plurality of rectangular projections (259) that can be inserted into said notches (256) and orbited within said expanded portion (257) of said end of said first header pipe (1), wherein said plugging member (258) can be screwed into and off said expanded portion (257), thereby enabling said desiccant (13) to be exchanged.

19. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (300) comprises a block member (320) that is brazed to an end of said first header pipe (1) and having a center hole (280) and a couple of slits (324) that is in connection with said center hole (280) and provided in a plane perpendicular to the axis of said first header pipe (1), a U-shaped stopper member (327) that is inserted into said slits, and a plugging member (325) having on its outer surface a circular groove (326), wherein said plugging member can be straightly inserted into said block member and locked by inserting said stopper member into said slits, and said plugging member can be released by pulling out said stopper member from said slits, thereby enabling said desiccant (13) to be exchanged.

20. A multi flow type sub cool condenser (1000) of claim 19, wherein said stopper member has arms of a length that can be folded to embrace said block member (320) after it is inserted into said slits (324).

21. A multi-flow type sub cool condenser (1000) of claim 19, wherein said stopper member has for one arm a length that can be folded to embrace said block member (320) and engage with the tip of the other arm after said stopper member (333) is inserted into said slits (324).

22. A multi-flow type sub cool condenser (1000) of claim 19, wherein a side plate (16) that is brazed to the outermost corrugated fin (5) has at its terminal end a couple of ear portions (340) having holes for passing a bolt, and said stopper member (338) has in its arms a hole (343a) and a female screw (343b), wherein after adjusting these holes and female screw, a bolt (341) can be screwed to fix them and can be released, thereby enabling said desiccant to be exchanged.

23. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (300) comprises a block member (347) that is brazed to an end of said first header pipe (1) and having a center hole (280) and a couple of slits (348) that is in connection with said center hole (280) and provided in a plane perpendicular to the axis of said first header pipe (1), a U-shaped stopper member (346) that is inserted into said slits, and a plugging member (345) having a outer surface (344b), wherein said plugging member can be straightly inserted into said block member (347) and locked by inserting said stopper member into said slits, and said plugging member can be released by pulling out said stopper member from said slits, thereby enabling said desiccant (13) to be exchanged, wherein in a state in which said plugging member is locked, only one lateral side surface (346b) of said stopper member is engaging with said outer surface (344b) of said plugging member.

24. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (400) comprises a flange member (426) that is brazed to an end of said first header pipe (1) and having a center hole (280) and a couple of side flanges (428) to which female screw member (430) is attached, and a plugging member (421) having a center portion (433) that is inserted into said center hole (280) and fixed by screws (431), wherein said plugging member (421) can be straightly inserted into said flange member (426) and locked by said screws (431) screwed into said female screw member (430) via said side flange (428), and said plugging member (421) can also be detached by unbolting, thereby enabling said desiccant (13) to be exchanged.

25. A multi-flow type sub cool condenser (1000) of claim 14, 19 or 24, wherein around said plugging member (243, 325, 421) is fitted an 0-ring (249, 328, 434) for hermetical sealing.

26. A multi-flow type sub cool condenser (1000) of claim 24, wherein in the middle portion of said female screw member (430) an expanded portion (435) is provided to limit the insertion length of said screw member (430) into said side flange (428).

27. A multi-flow type sub cool condenser (1000) of claim 1, wherein said plugging mechanism (400) comprises a flange member (440) that is brazed to an end of said first header pipe (1) and having a center hole (280) and an overhanged flange (438) and a portion made by folding and squashing the other flange to which female screw (441) is bored, and a plugging member (437) having a side flange (437b) and a center portion (433) that is inserted into said center hole (280) and fixed by screws (431) and having a short flange (437a) that engages with said overhanged flange (438), wherein said plugging member (437) can be straightly inserted into said flange member (440) and locked by single screw (431) screwed into said female screw (441) via said side flange (437b), and said plugging member (437) can also be detached by unbolting, thereby enabling said desiccant (13) to be exchanged.

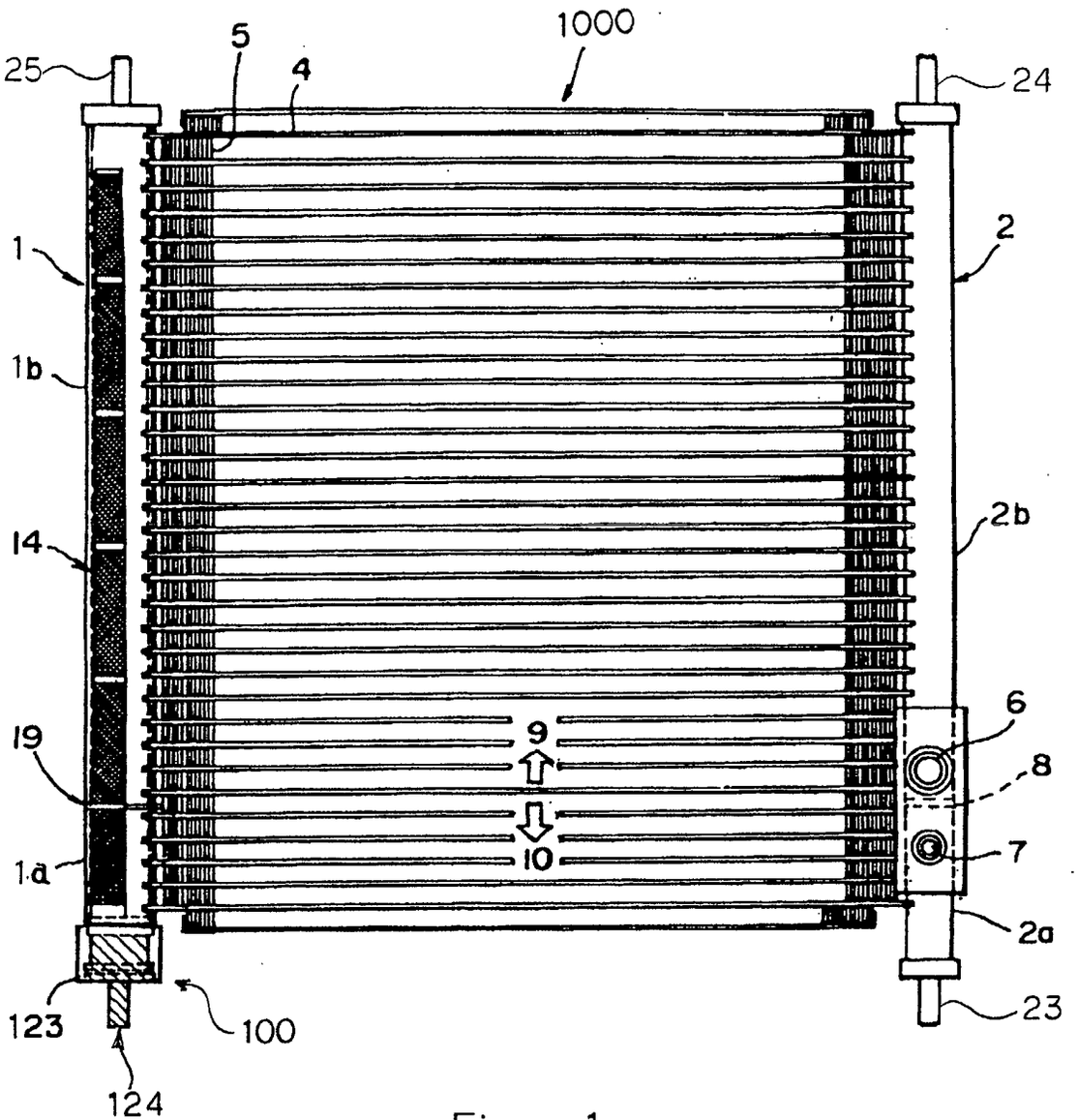
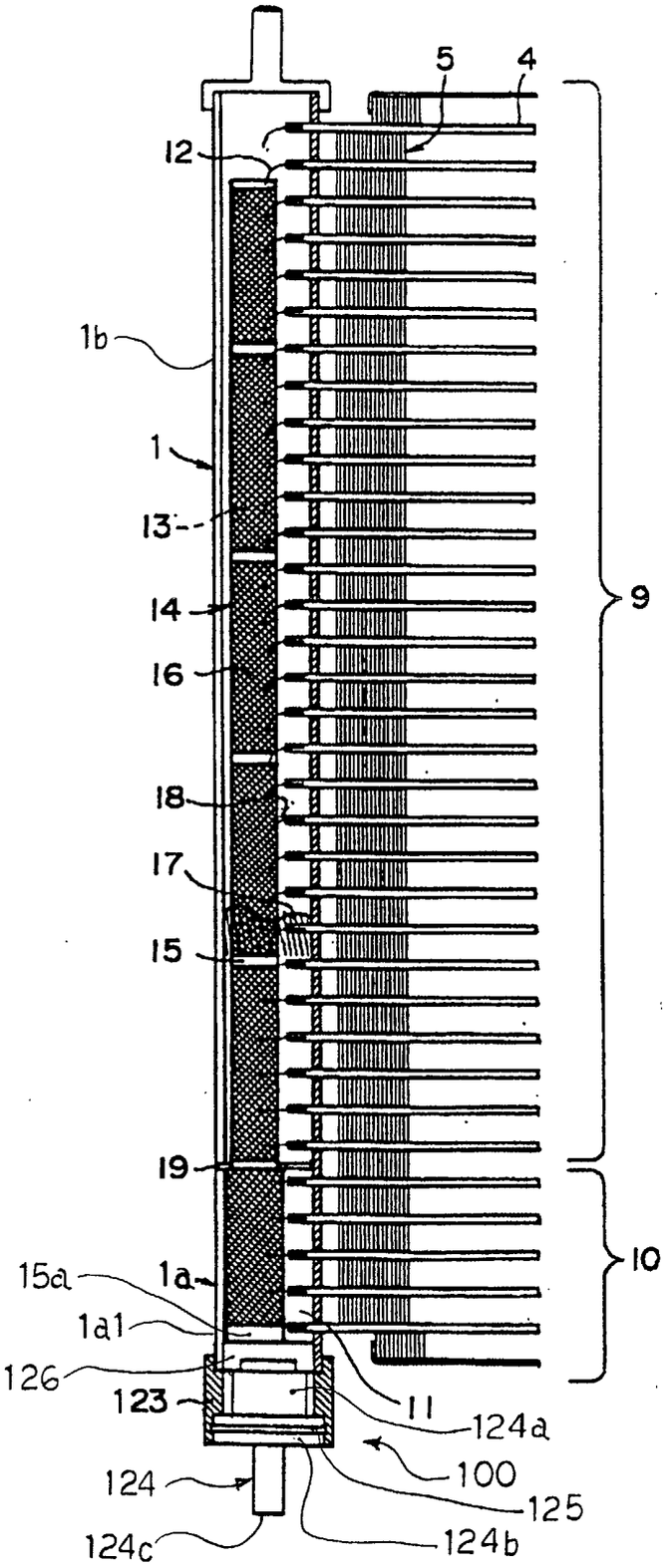


Fig. 1


5
4
12
1b
1
13
14
16
18
17
15
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15a
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123
11
124a
100
125
124
124c
124b

Fig . 2

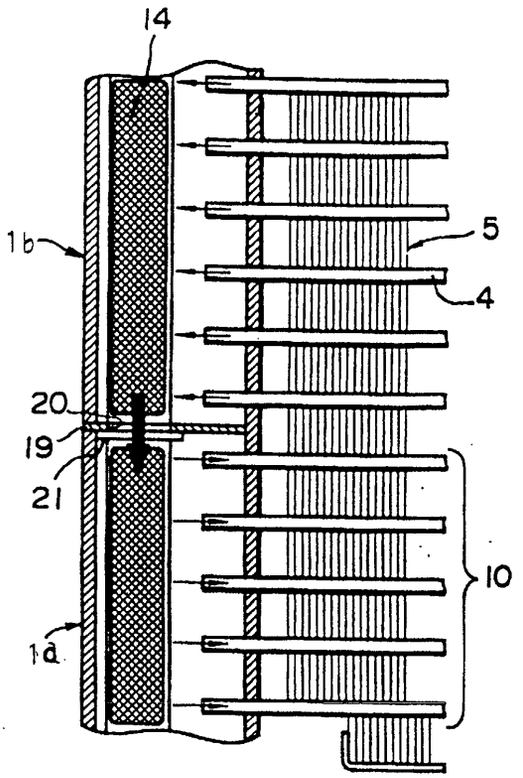


Fig . 3

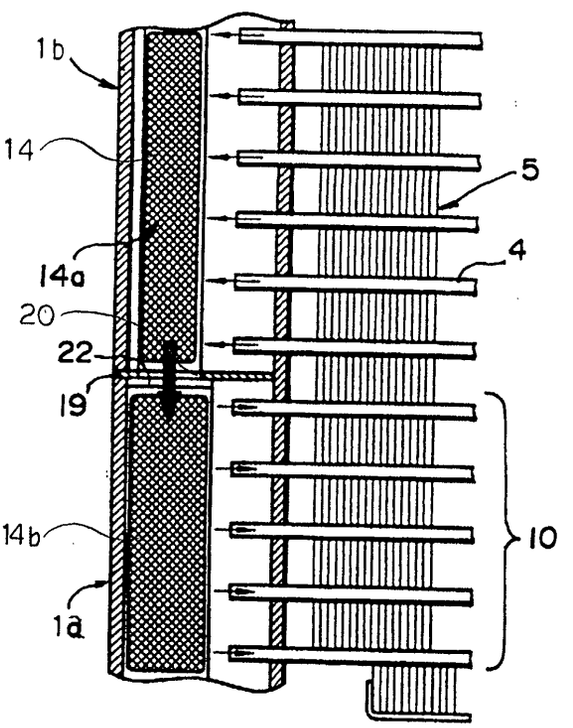


Fig . 4

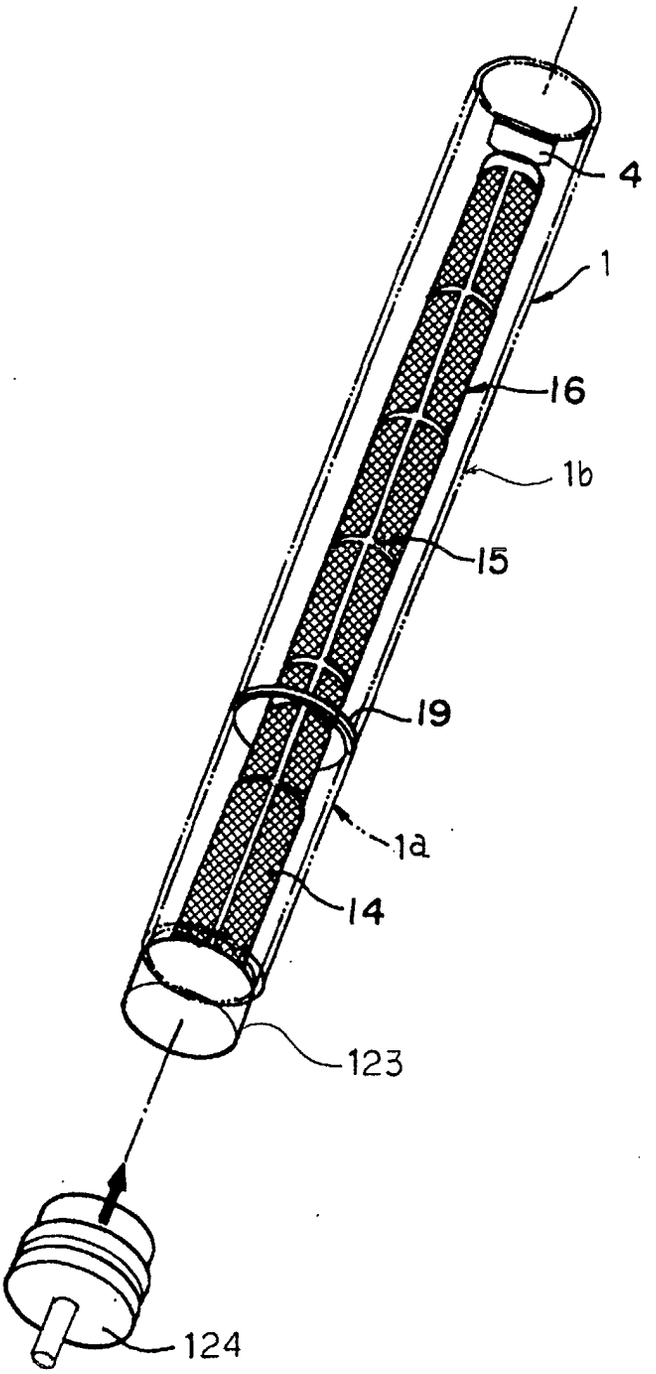


Fig . 5

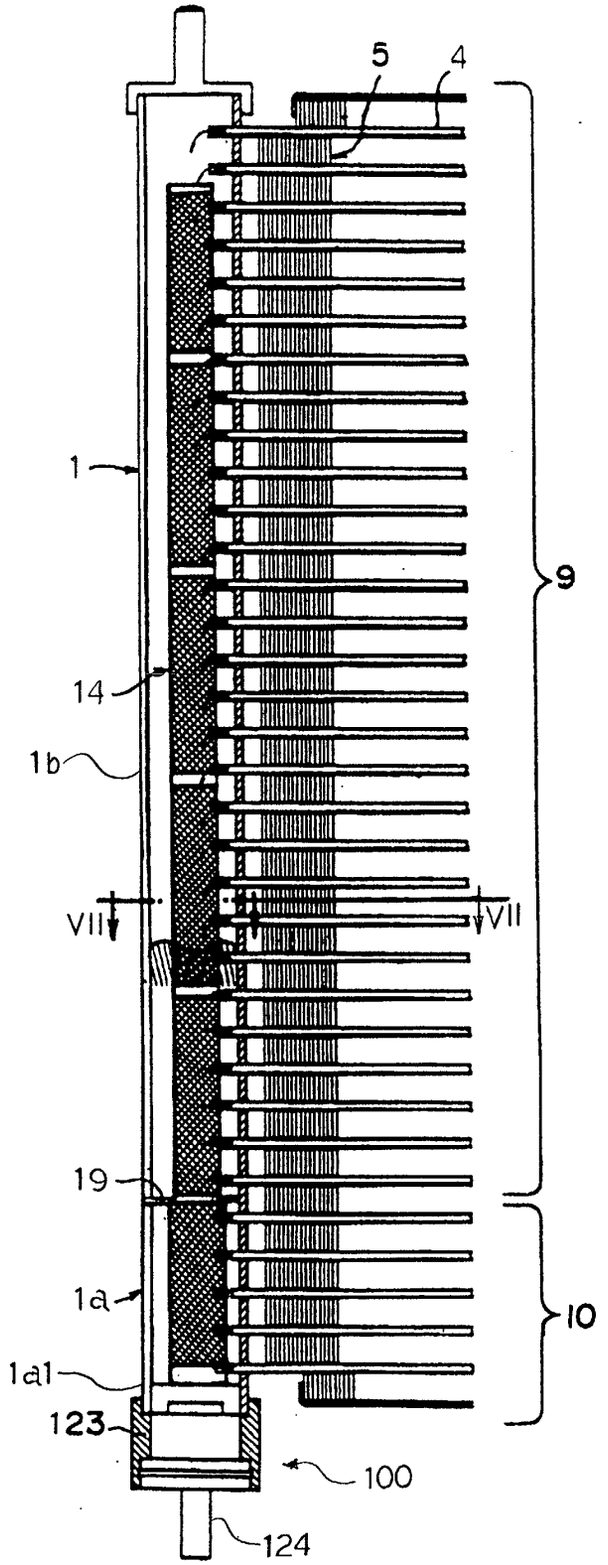


Fig . 6

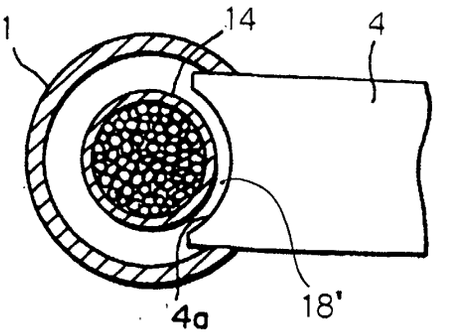


Fig . 7

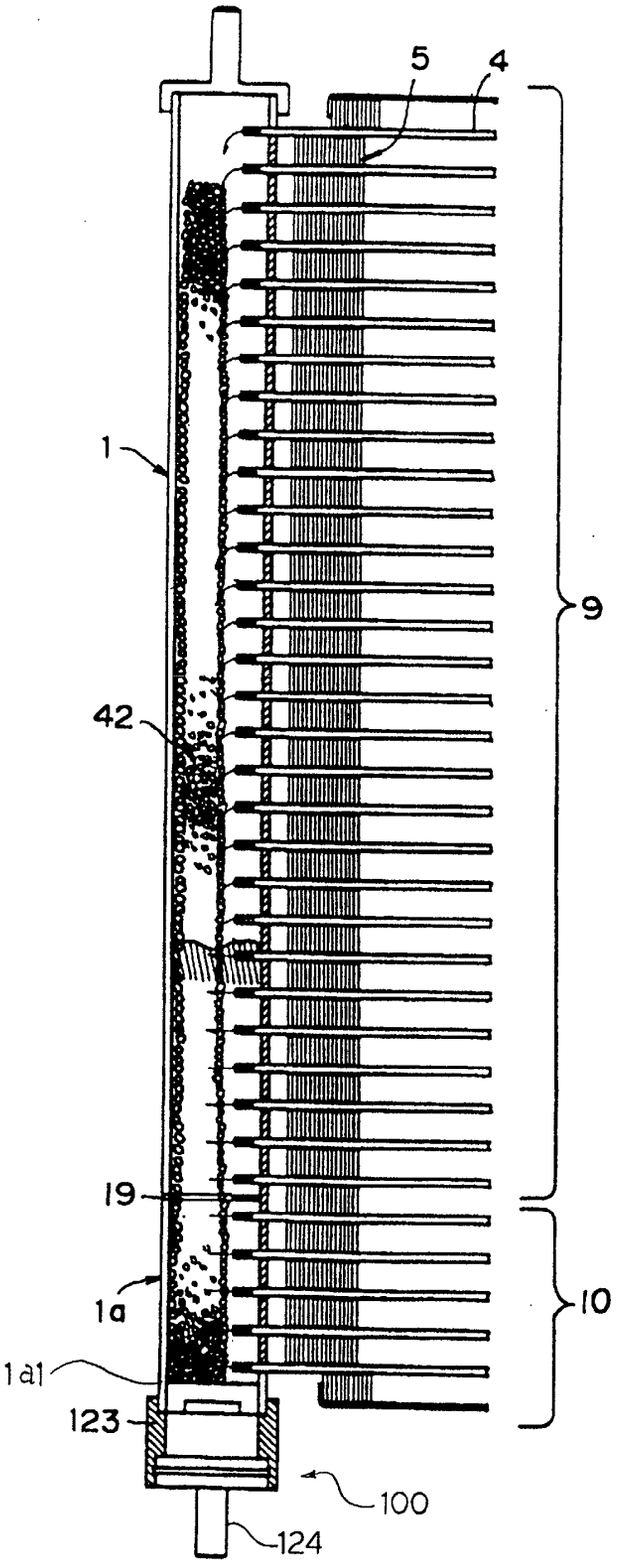


Fig . 8

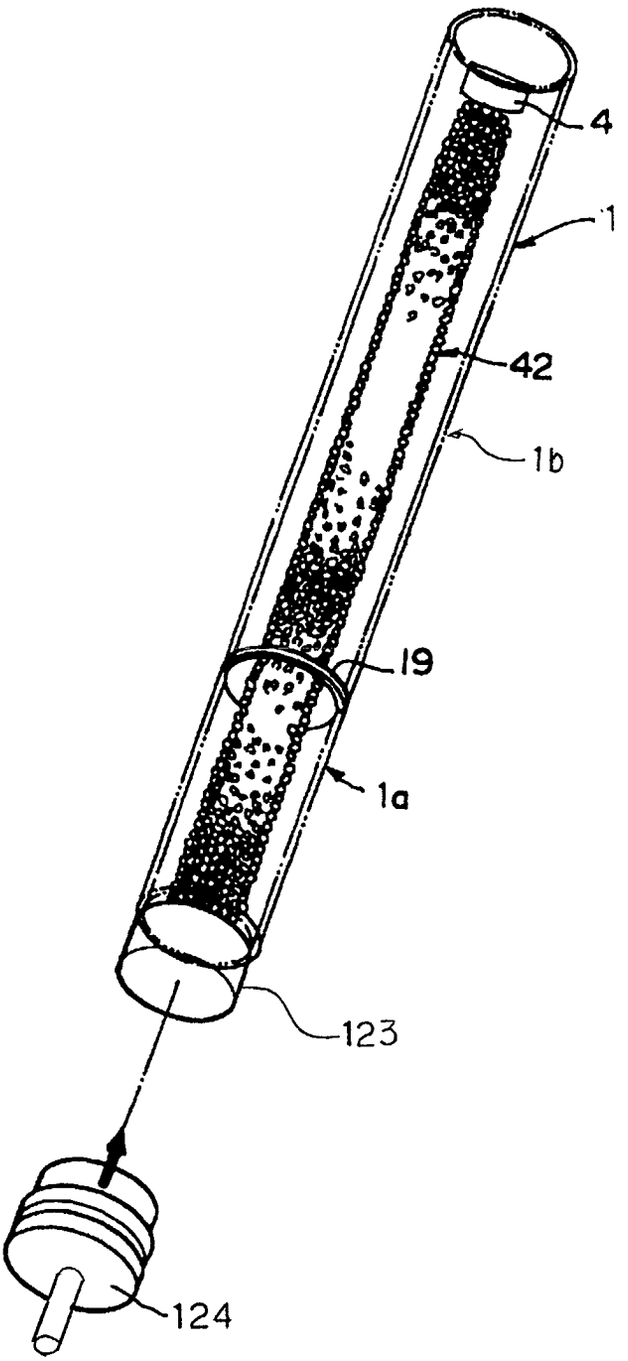


Fig . 9

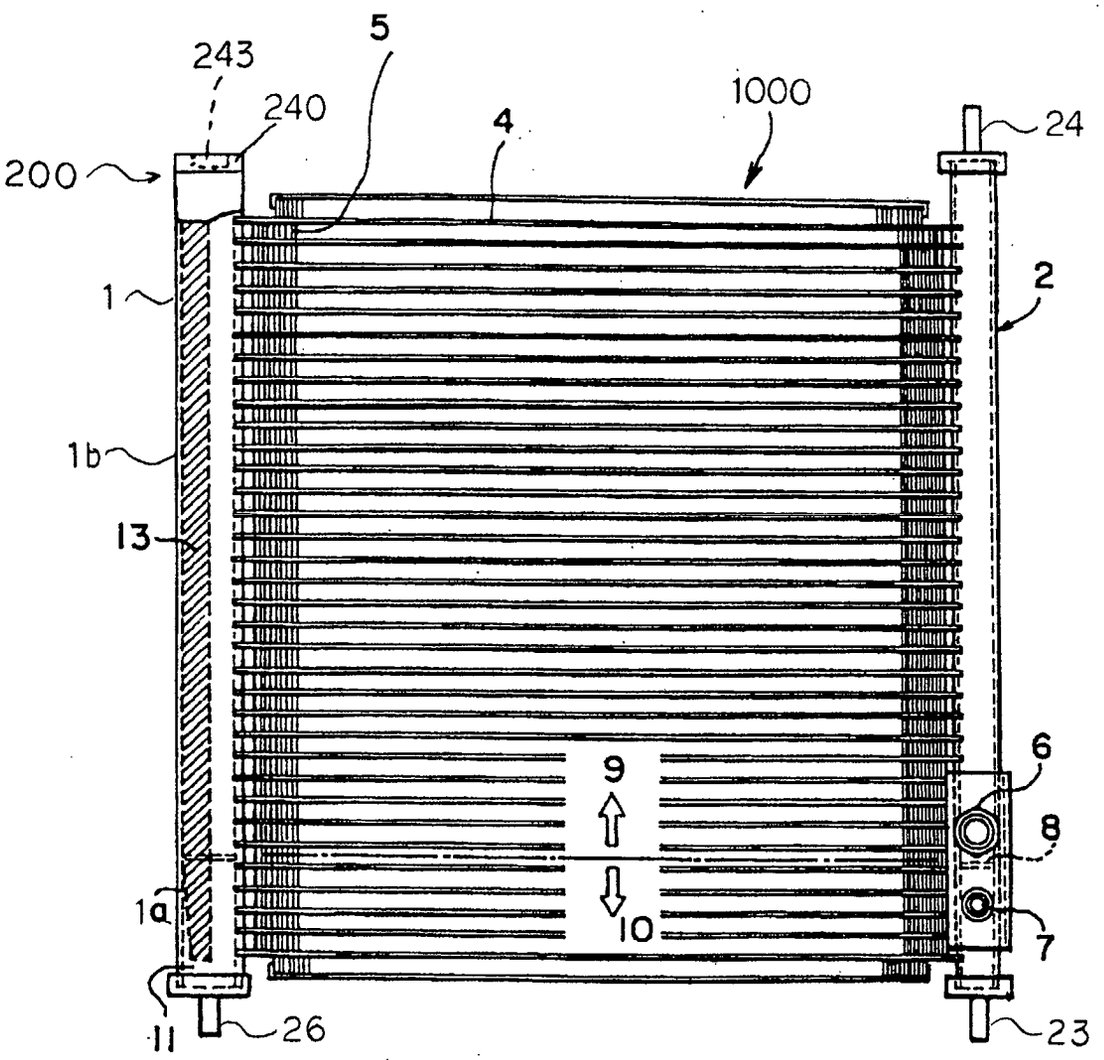


Fig . 10

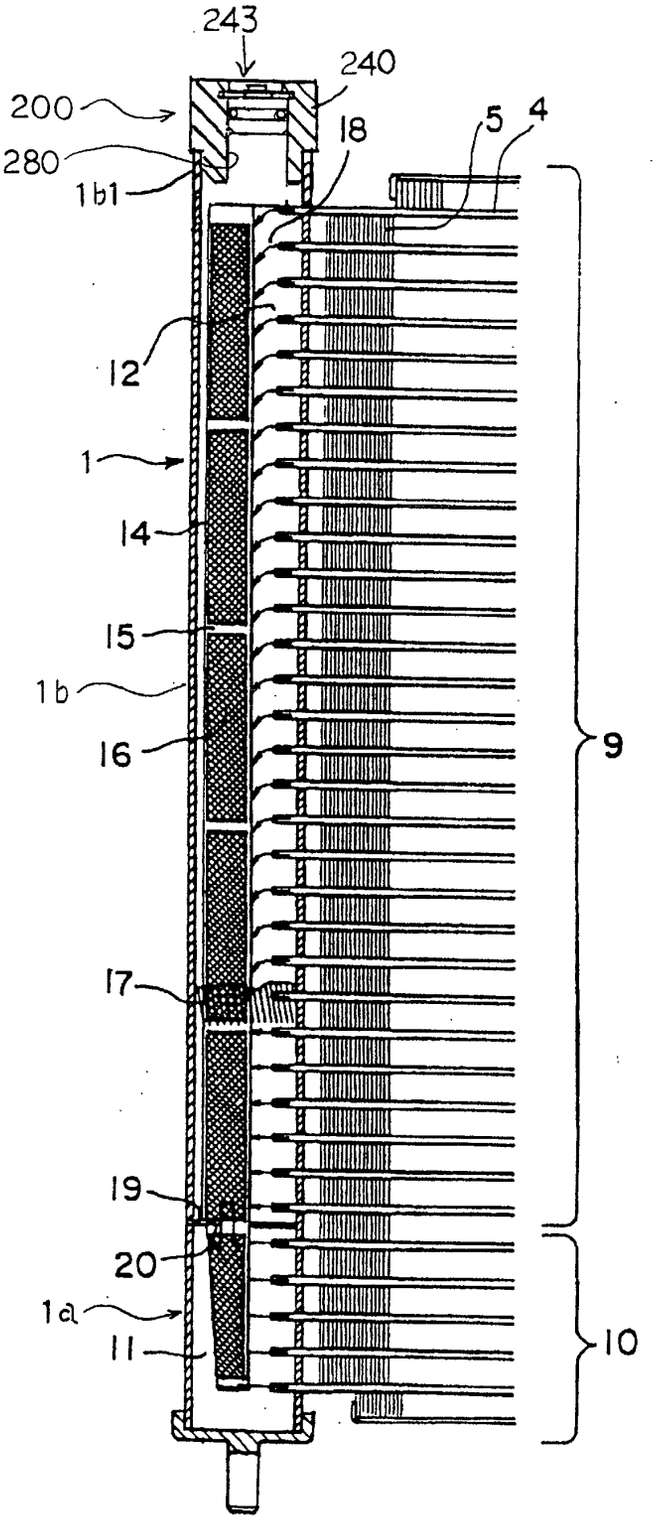


Fig . 11

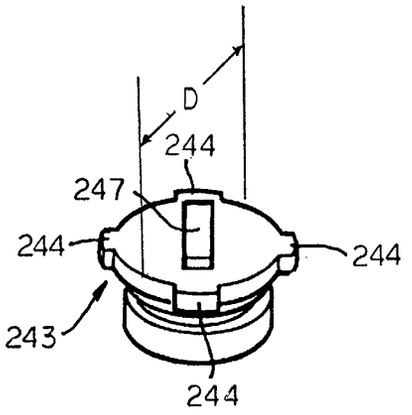


Fig . 12

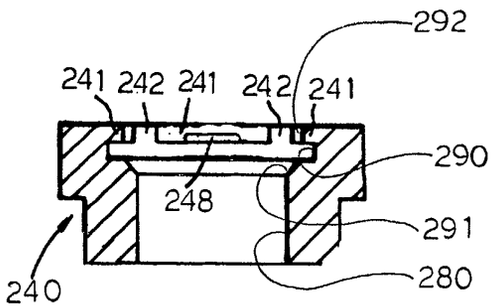


Fig . 13

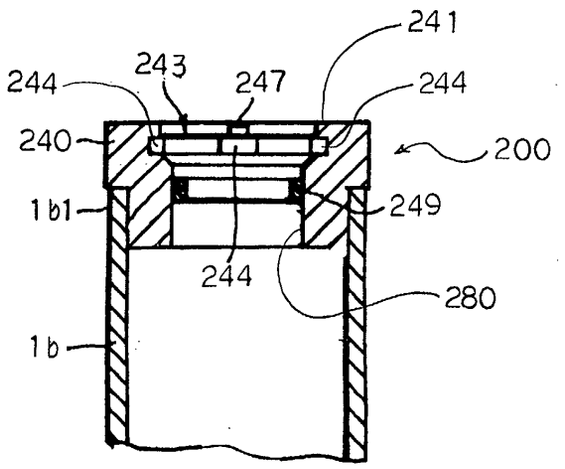


Fig . 14

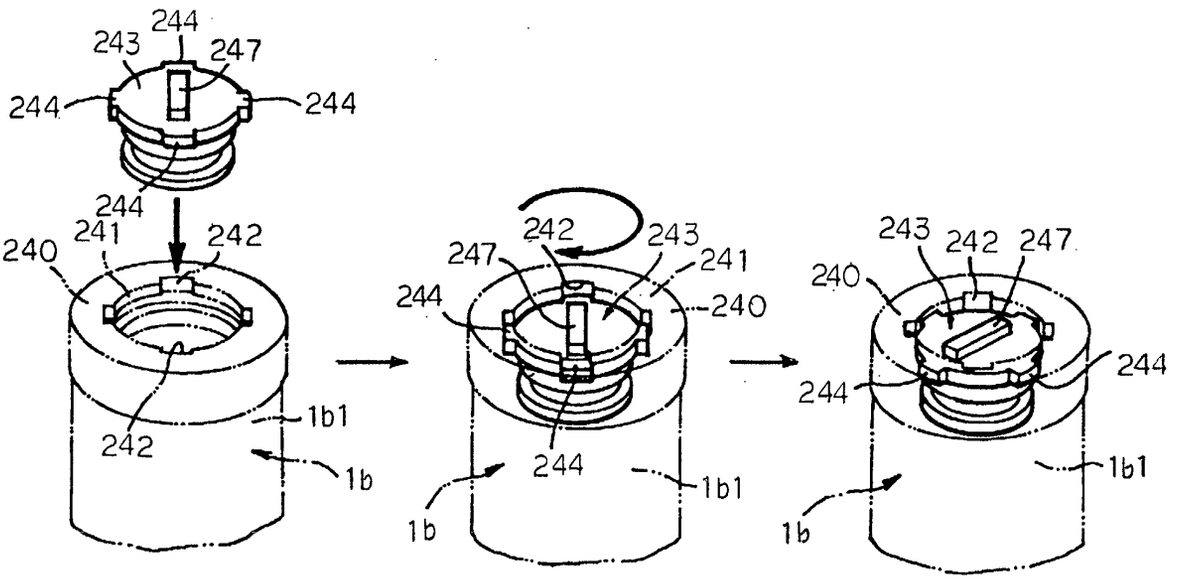


Fig . 15(a) Fig . 15 (b) Fig . 15 (c)

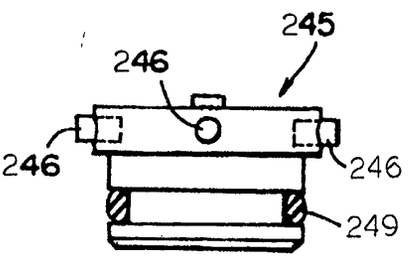


Fig . 16

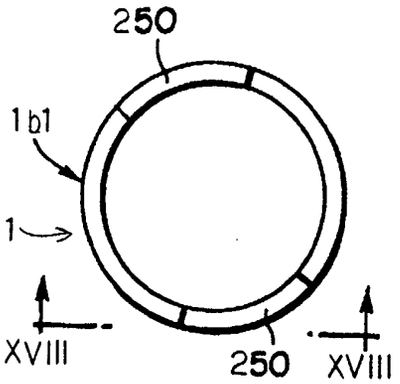


Fig. 17

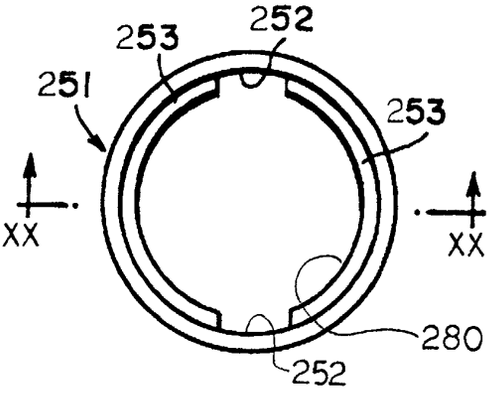


Fig. 19

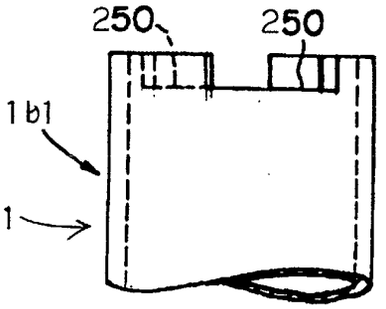


Fig. 18

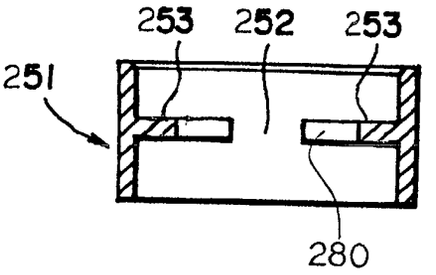


Fig. 20

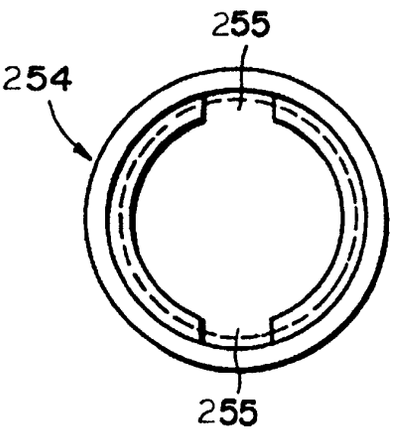


Fig. 22

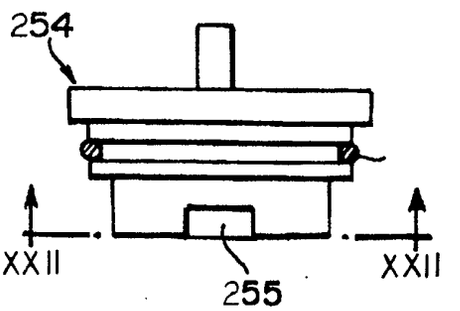


Fig. 21

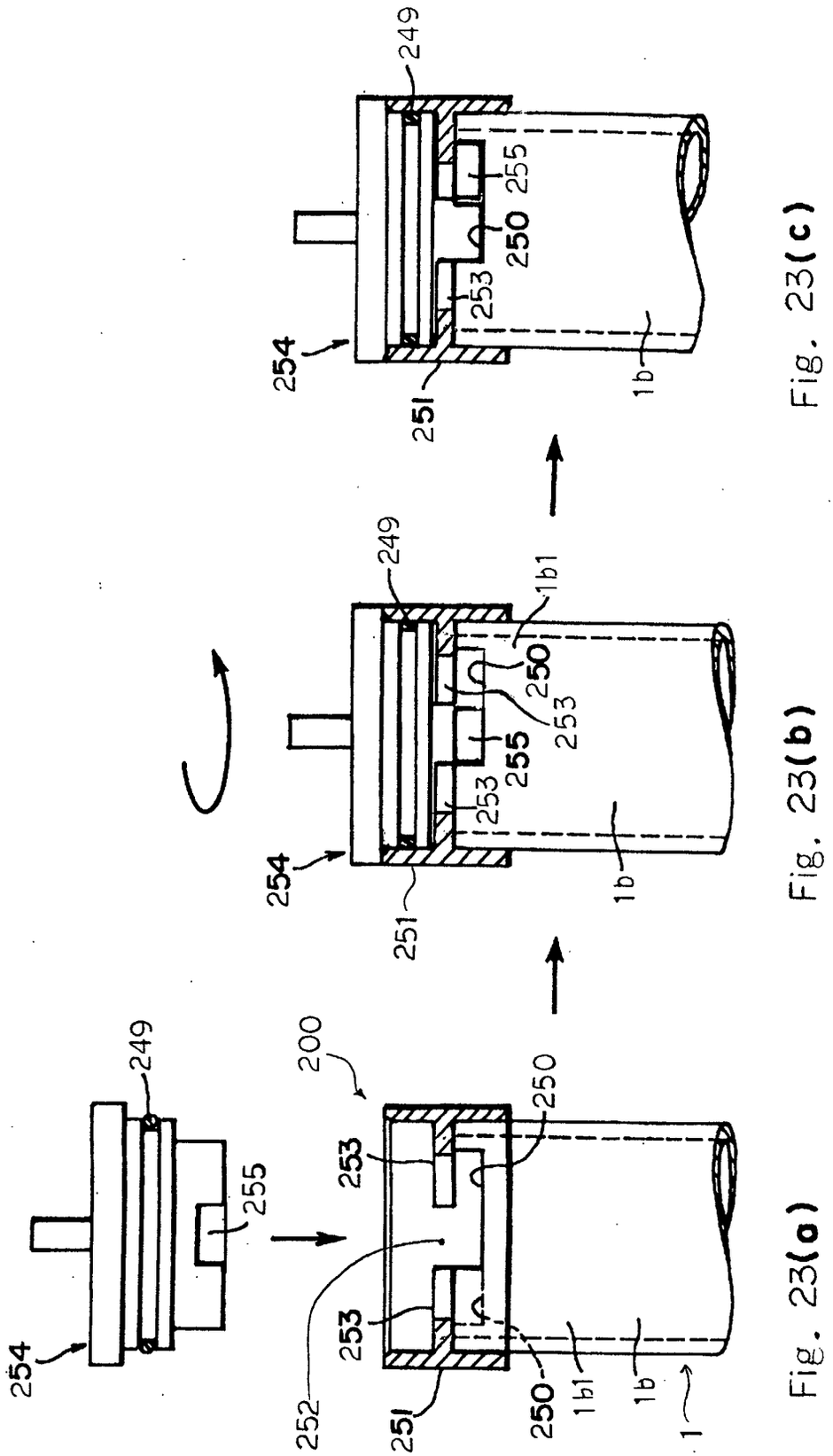


Fig. 23(a)

Fig. 23(b)

Fig. 23(c)

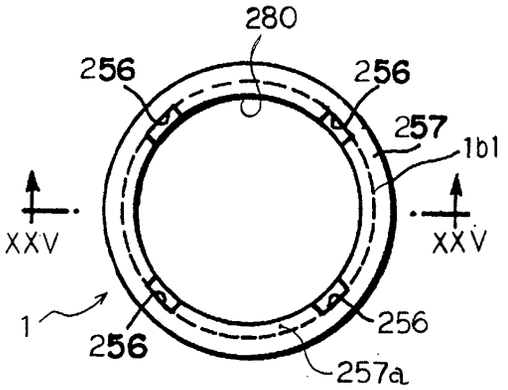


Fig . 24

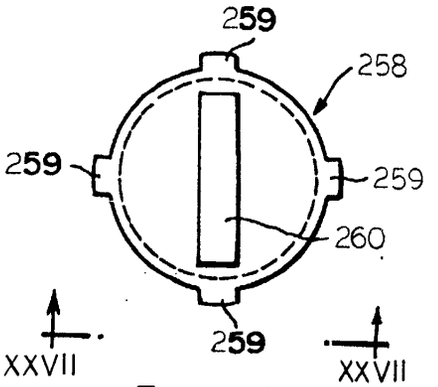


Fig . 26

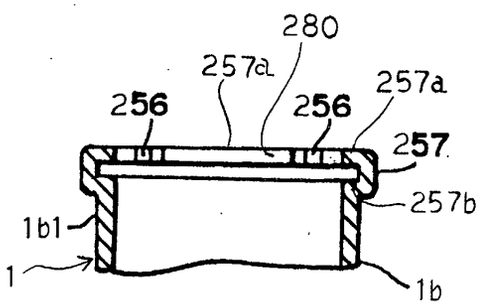


Fig . 25

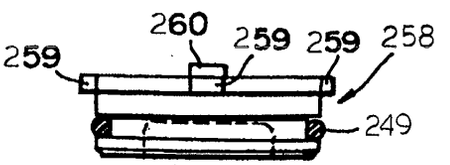


Fig . 27

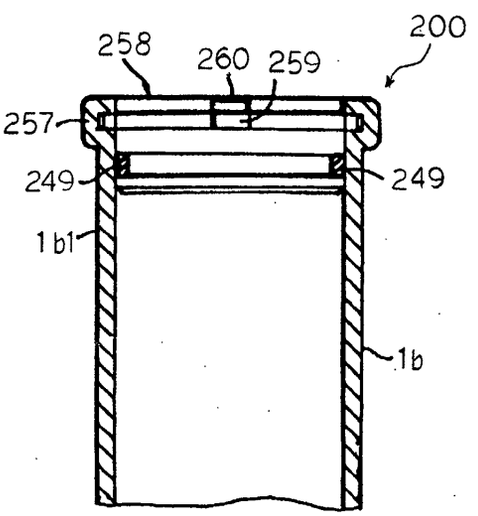


Fig . 28

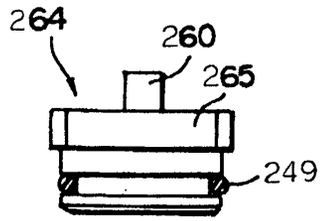


Fig . 29

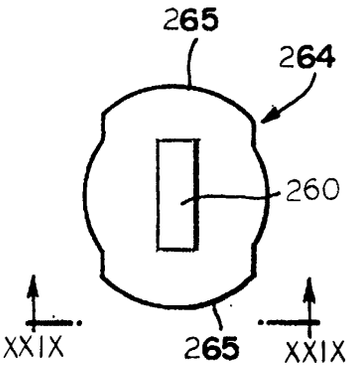


Fig . 30

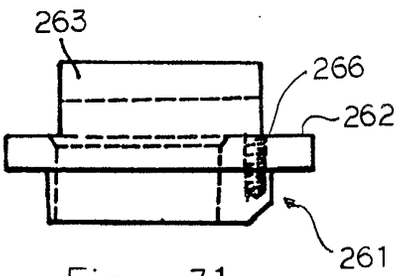


Fig . 31

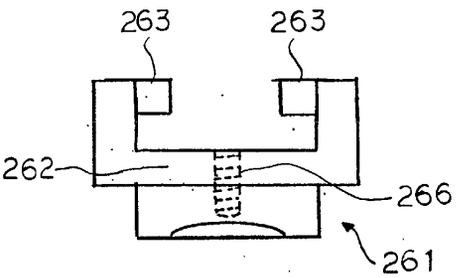


Fig . 32

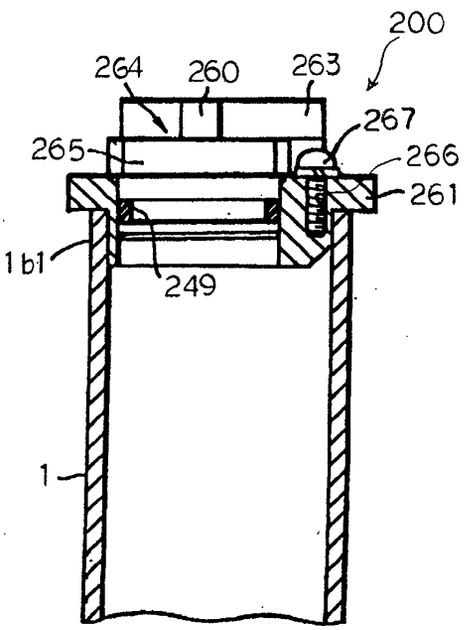


Fig . 34

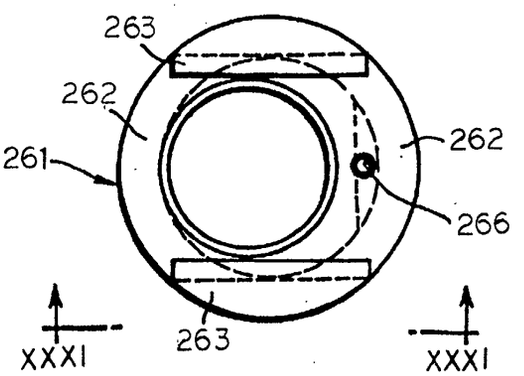


Fig . 33

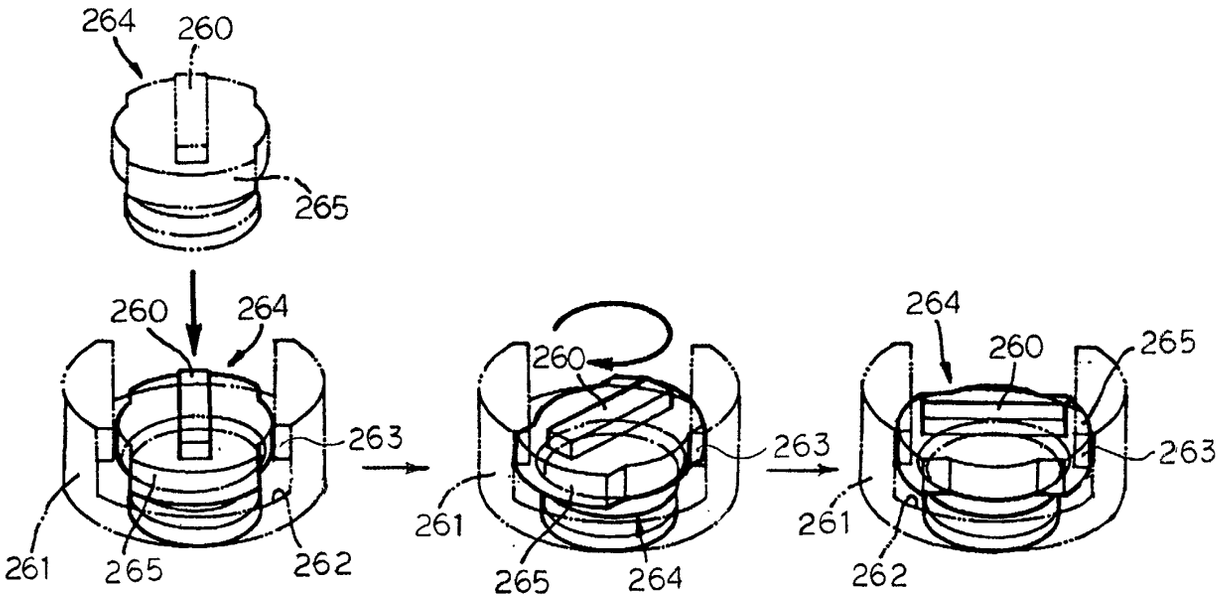
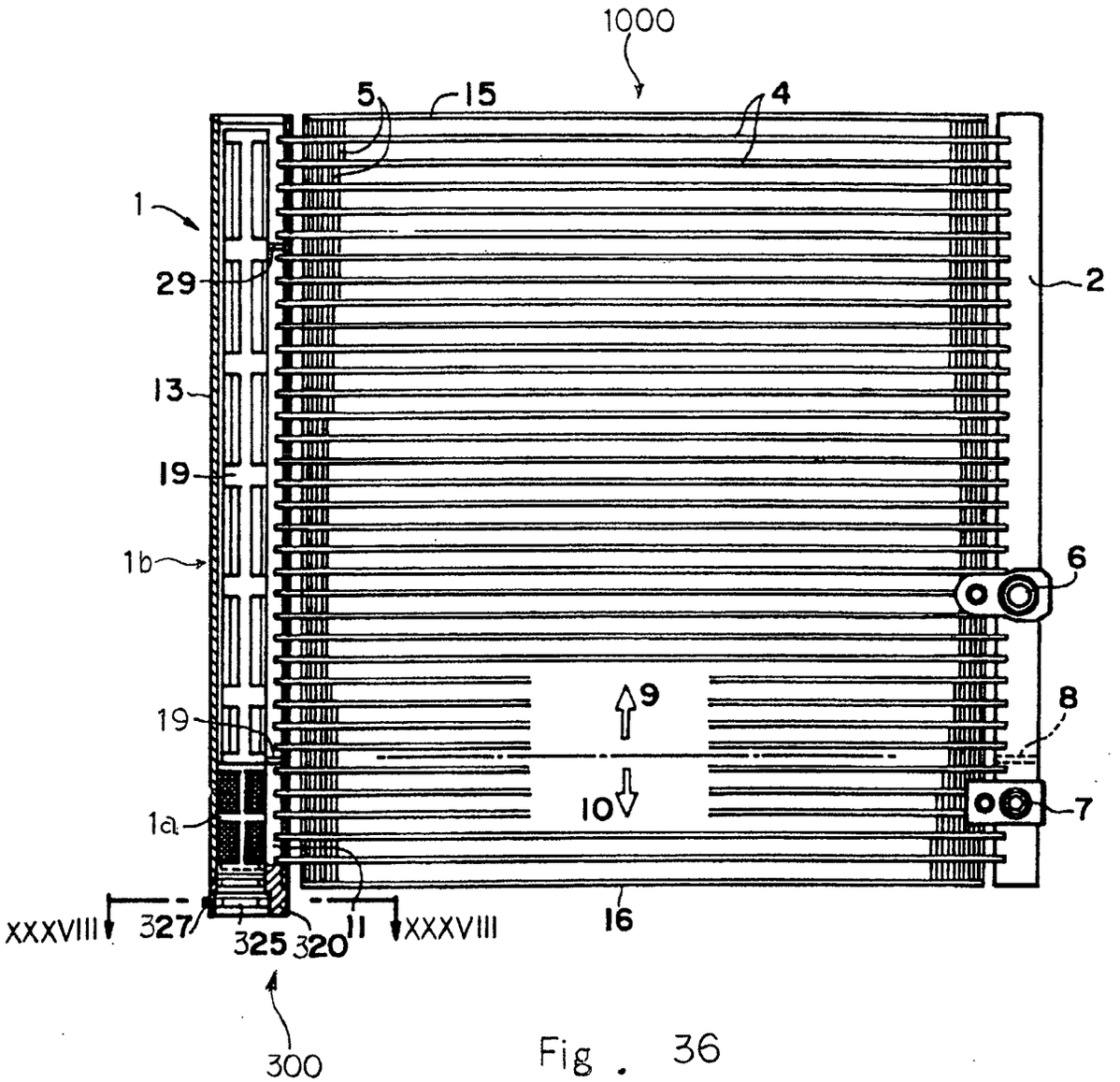


Fig . 35(a) Fig . 35 (b) Fig . 35 (c)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8
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7
1a
XXXVIII
327
325
320
11
XXXVIII
16
300

Fig. 36

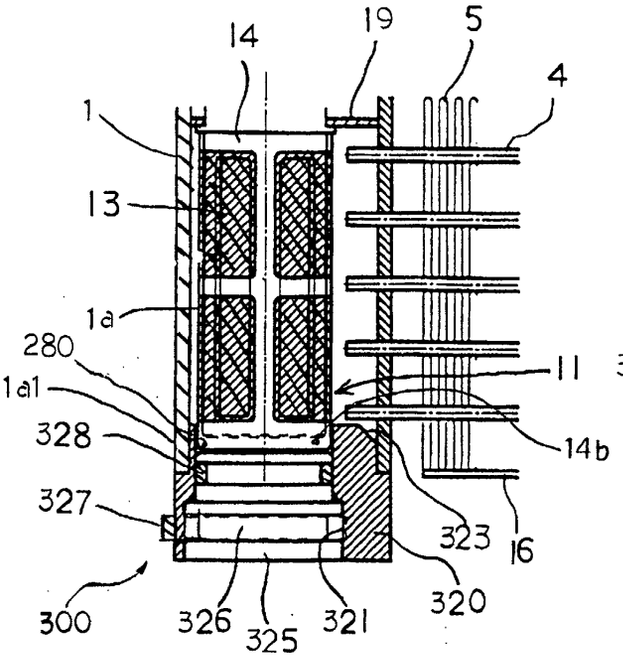


Fig . 37

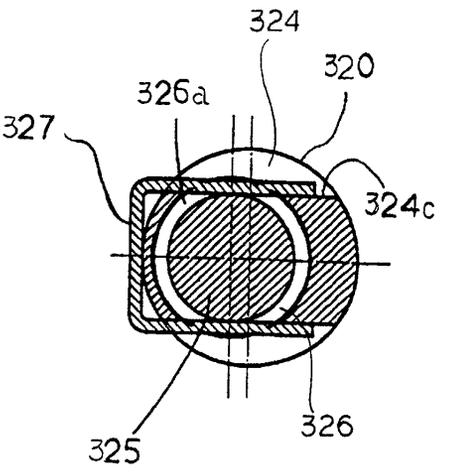


Fig . 38

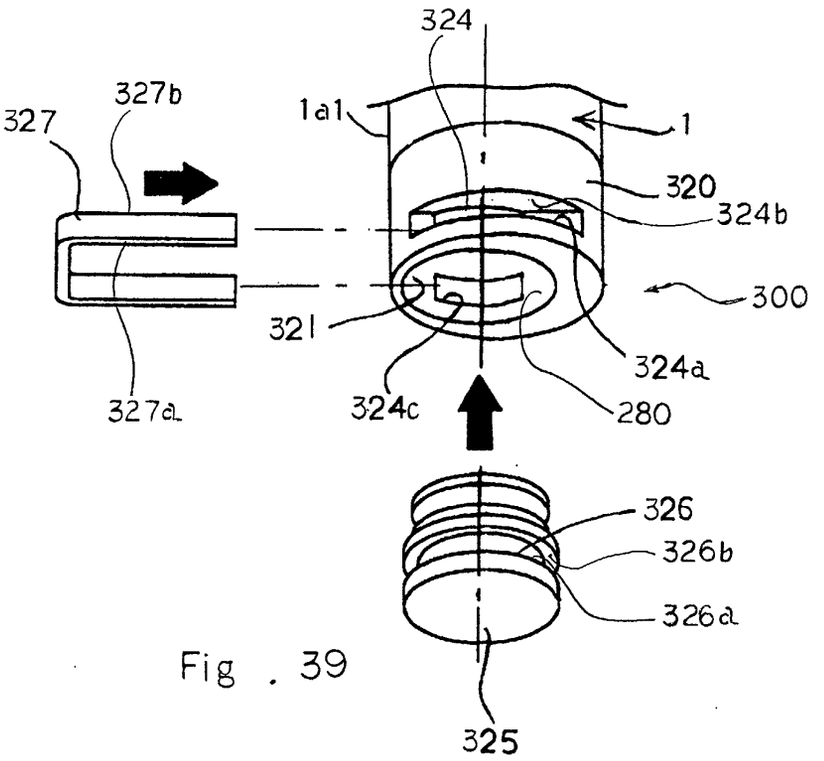


Fig . 39

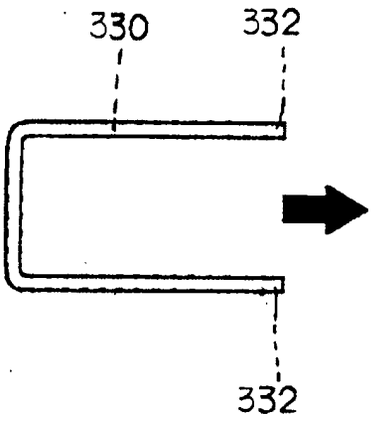


Fig . 40(a)

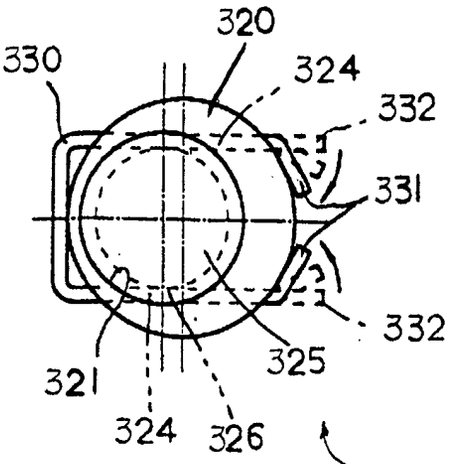


Fig . 40(b)

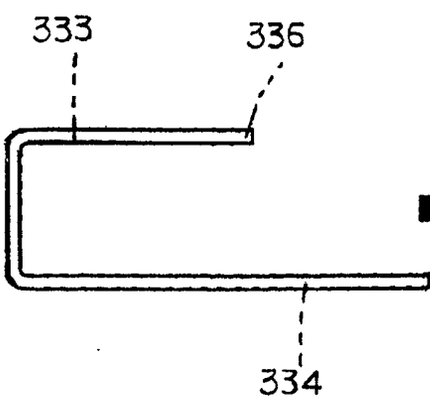


Fig . 41(a)

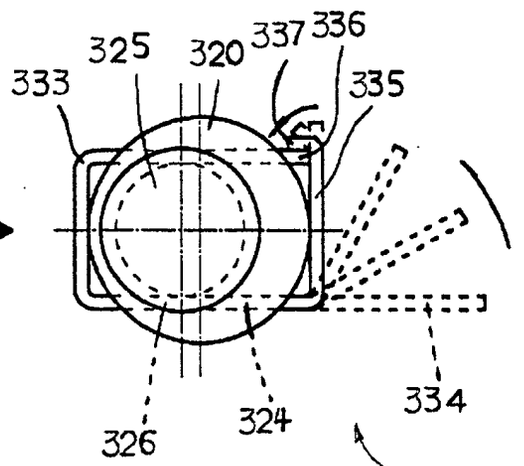


Fig . 41(b)

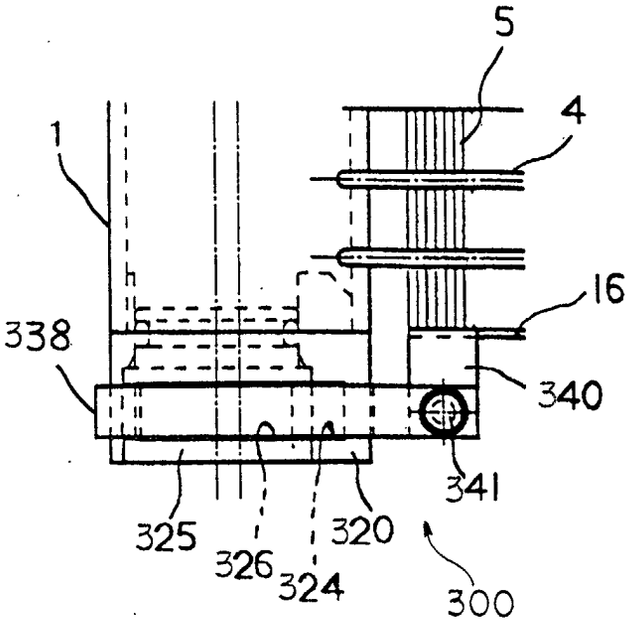


Fig . 42

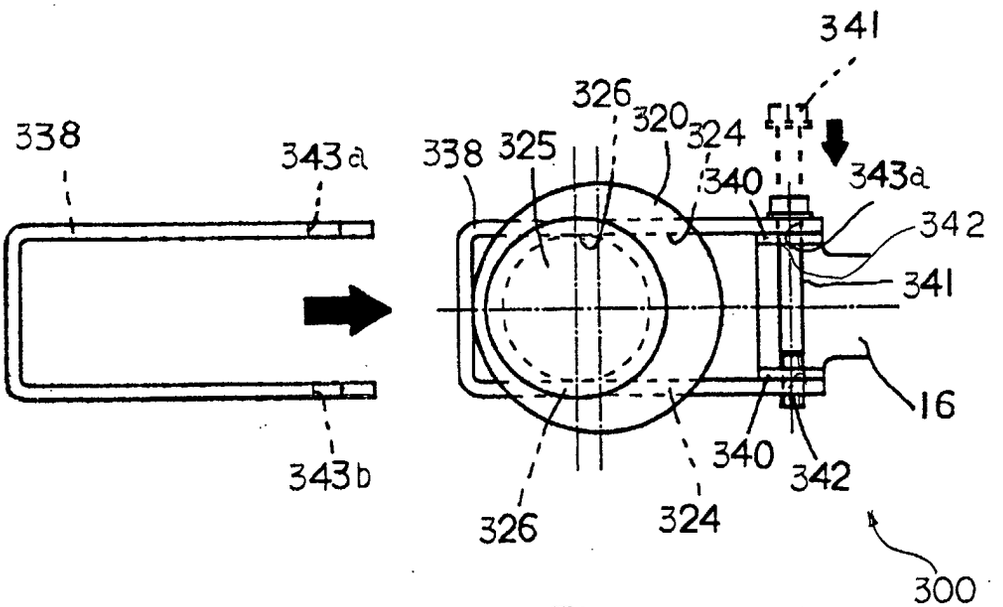
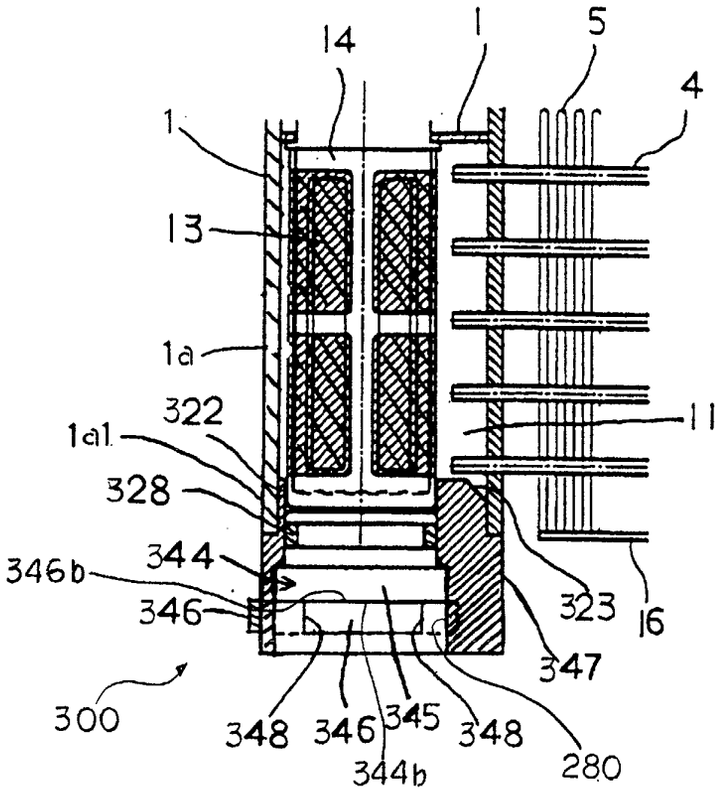


Fig . 43 (a)

Fig . 43 (b)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323
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280
344b

Fig . 44

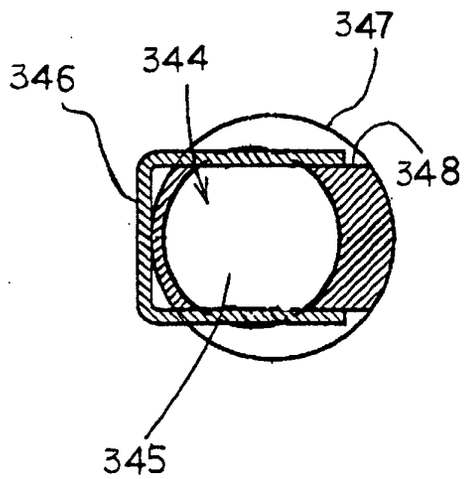
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Fig . 45

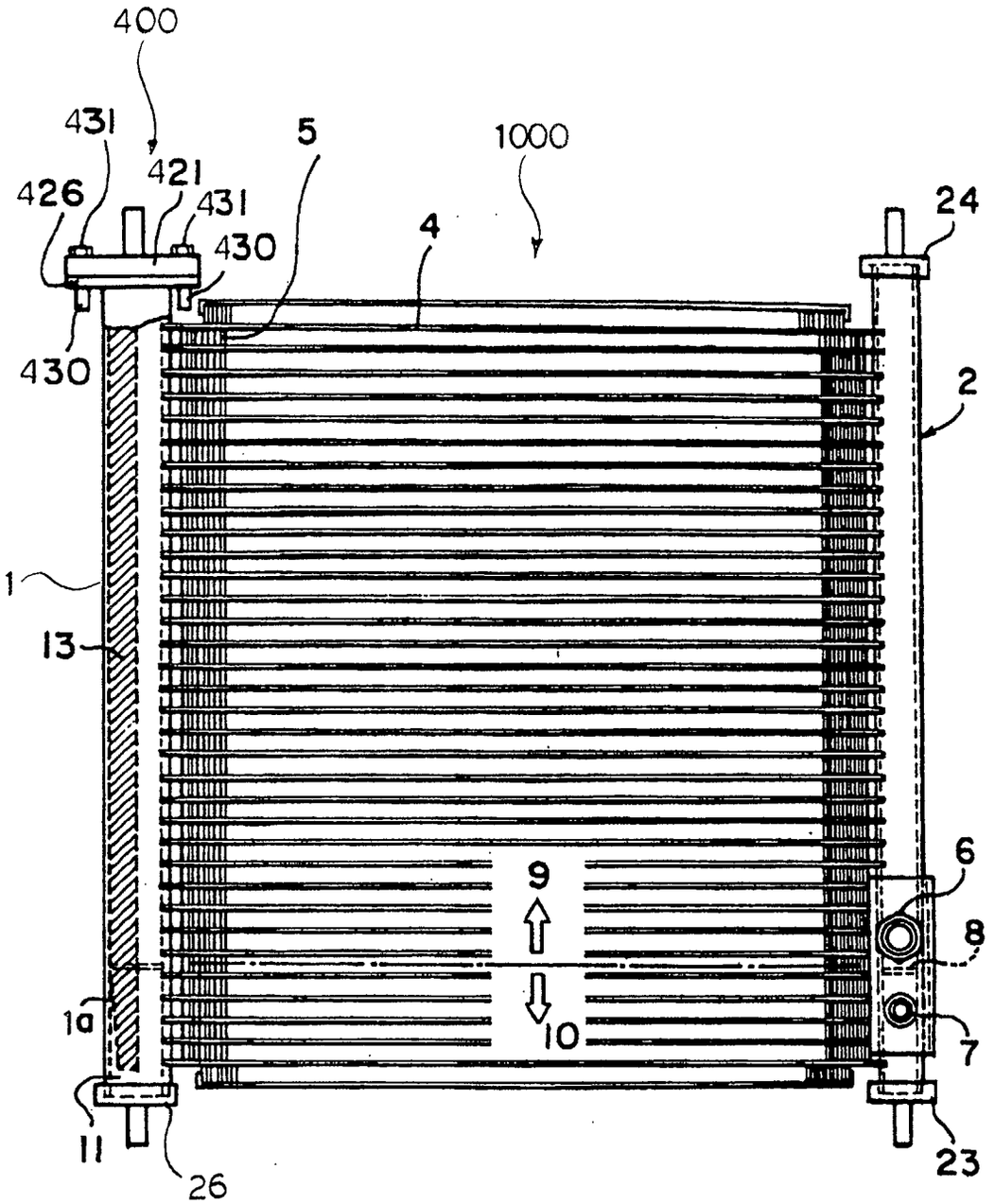
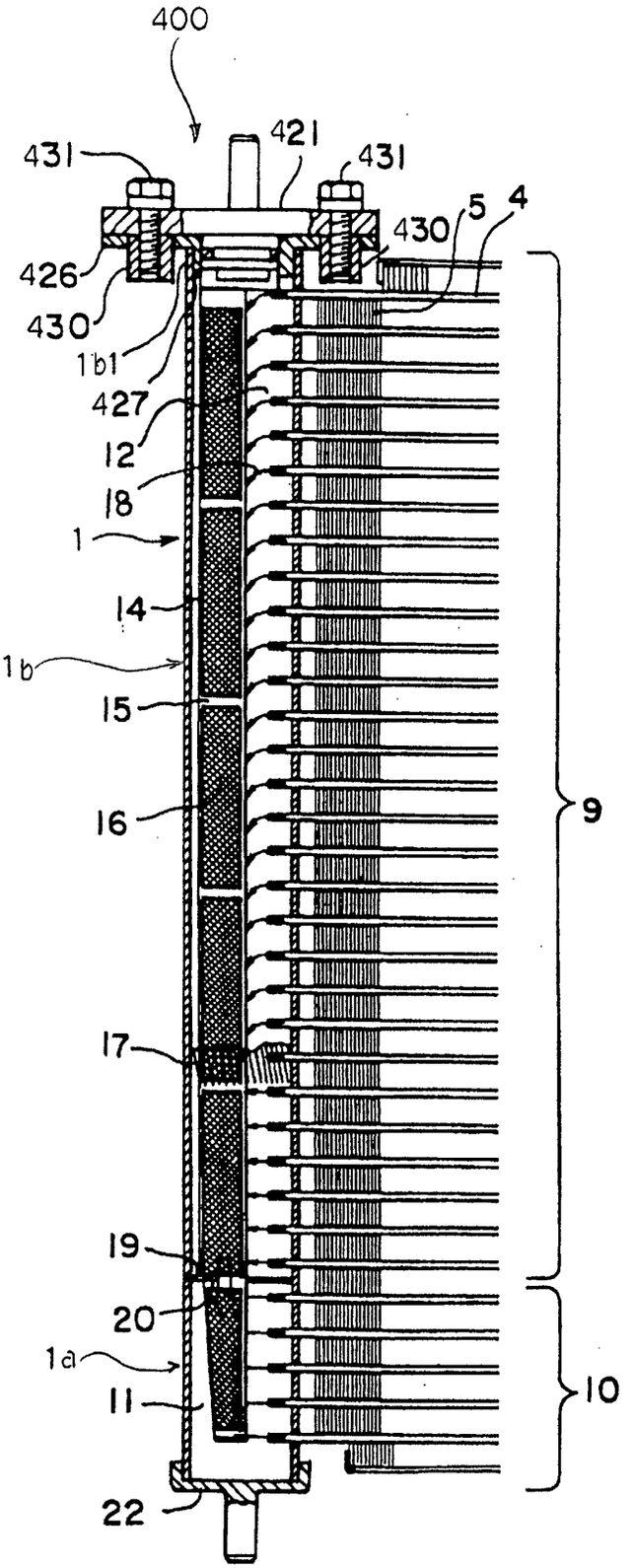


Fig . 46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1a
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22
9
10

Fig . 47

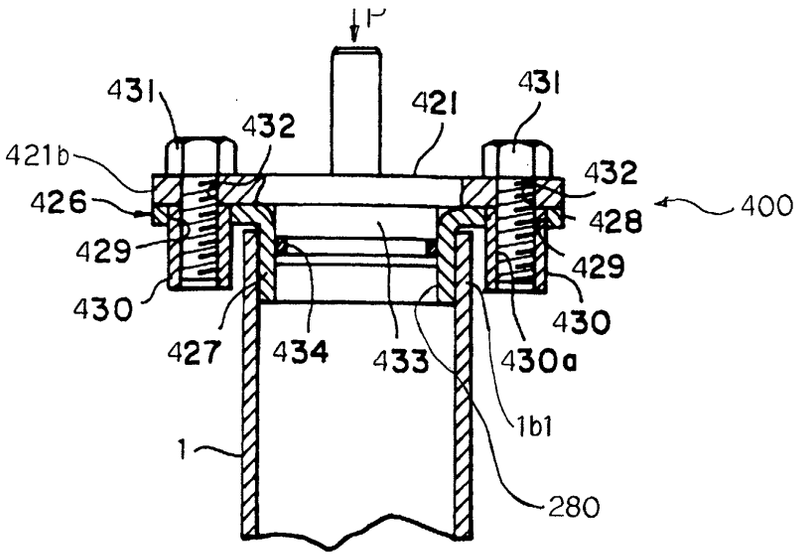


Fig . 48

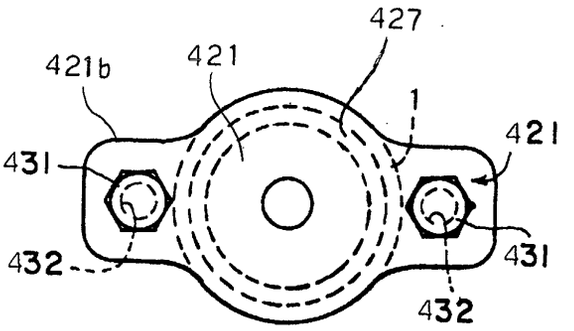


Fig . 49

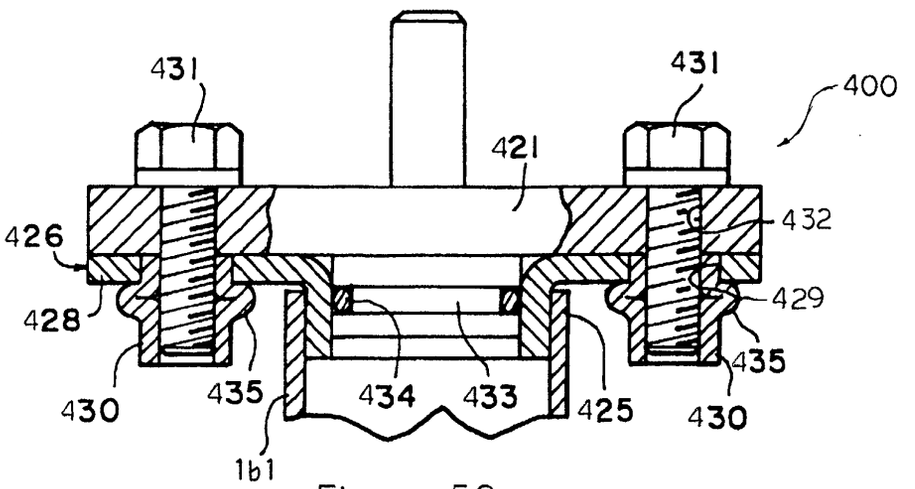
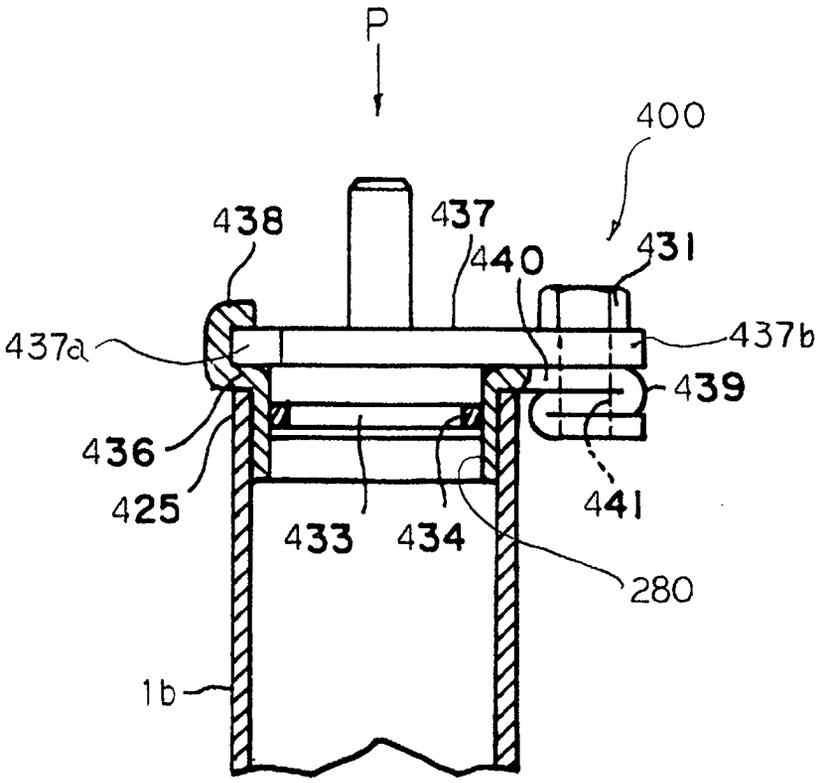


Fig . 50


P
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280
1b

Fig . 51

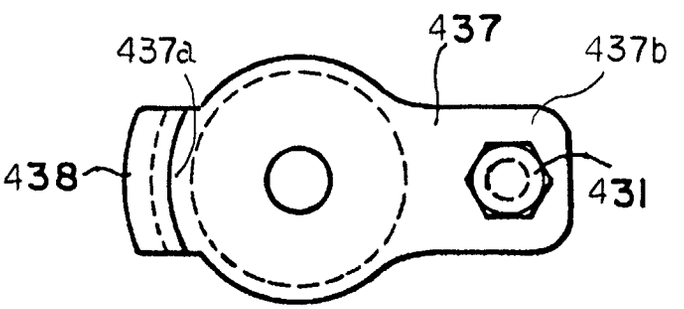
437a
437
437b
438
431

Fig . 52