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(54) **Pump device**

(57) A pump device comprising a pump housing including a fluid chamber for inhaling a fluid flowing through the fluid chamber via an intake port and discharging the fluid to an outside via a discharge port, a motor housing including a stator, a shaft whose one end projects into the pump housing and to which an impeller is assembled and whose the other end is rotatably supported by a first bearing portion within the motor hous-

ing, a rotor assembled to the shaft and facing the stator, and a bearing plate disposed between the pump housing and the motor housing and including a second bearing portion rotatably supporting the shaft characterized in that the bearing plate is formed by a first fluid passage for leading the fluid to the bearing plate.

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Description

FIELD OF THE INVENTION

[0001] This invention generally relates to a pump device. More particularly, the invention pertains to a pump device for pressurizing and supplying a fluid by a rotation of an impeller driven by a motor.

BACKGROUND

[0002] Known pump device circulates a fluid for cooling and lubrication flowing from an intake port through a circulation path by a rotation of an impeller, thereby achieving cooling and lubrication of a predetermined portion. Such a pump device is disclosed in Japanese Patent Laid-Open Publication No. H07-217593. The disclosed pump device includes an impeller being rotatably supported on a shaft within a casing. Rotating the impeller by a rotation of the shaft causes the fluid on an intake side (feed side) where the fluid is inhaled to be supplied to a discharge side for circulating the fluid through the circulation path.

[0003] According to the above-mentioned pump device, the shaft supporting the impeller is rotatably supported by a bearing portion formed within the casing. The bearing portion and the discharge side are connected by a piping outside of the casing so that a part of the fluid with a high pressure on the discharge side is supplied to the bearing portion that supports the impeller.

[0004] According to the above-mentioned structure, however, the piping for leading the fluid to the bearing portion is required to be provided outside of the casing, thereby causing a large size of the pump device.

[0005] Further, a gap formed between the bearing portion and the shaft is defined with a high dimensional accuracy so that no looseness causes in case of the impeller rotating. Thus, a foreign matter entering into the gap between the bearing portion and the shaft may be pinched therebetween. Then, the foreign matter does not easily come out from the gap, thereby causing a malfunction of the bearing portion, which leads a deterioration of the pump device life.

[0006] Thus, a need exists for a pump device that can achieve a downsizing without a piping provided outside of the device. In addition, a need exists for the pump device which protects a bearing portion by preventing the foreign matter from entering.

SUMMARY OF THE INVENTION

[0007] According to an aspect of the present invention, a pump device comprising a pump housing including a fluid chamber for inhaling a fluid flowing through the fluid chamber via an intake port and discharging the fluid to an outside via a discharge port, a motor housing including a stator, a shaft whose one end projects into the pump housing and to which an impeller is assembled

and whose the other end is rotatably supported by a first bearing portion within the motor housing, a rotor assembled to the shaft and facing the stator, and a bearing plate disposed between the pump housing and the motor housing and including a second bearing portion rotatably supporting the shaft characterized in that the bearing plate is formed by a first fluid passage for leading the fluid to the bearing plate.

[0008] According to the aforementioned invention, the first fluid passage for leading the fluid into the bearing plate is formed within the bearing plate. Thus, an extra piping is not required to be employed outside of the pump device for leading the fluid to the bearing portion, thereby achieving a downsizing of the pump device as a whole. The first fluid passage through which the fluid is pressurized and sent to a required portion within the motor for lubrication or cooling is formed within the pump device, thereby achieving high space efficiency.

[0009] According to another aspect of the present invention, a pump device comprising a pump housing including a fluid chamber for inhaling a fluid flowing through the fluid chamber via an intake port and discharging the fluid to an outside via a discharge port, a motor housing including a stator, a shaft whose one end projects into the pump housing and to which an impeller is assembled and whose other end is rotatably supported by a first bearing portion within the motor housing, and a rotor assembled to the shaft and facing the stator characterized in that the impeller is formed by a first fluid passage extending in a radial direction of the impeller for leading the fluid to the first bearing portion.

[0010] According to the aforementioned invention, the first fluid passage is formed within the impeller in the radial direction for leading the fluid to the first bearing portion. Thus, an extra piping is not required to be provided outside of the pump device for leading the fluid to the first bearing portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The foregoing and additional features and characteristics of the present invention will become more apparent from the following detailed description considered with reference to the accompanying drawings, wherein:

[0012] Fig. 1 is a cross-sectional view of a pump device according to a first embodiment of the present invention; and

[0013] Fig. 2 is a cross-sectional view of the pump device according to a second embodiment of the present invention.

DETAILED DESCRIPTION

[0014] Embodiments of the present invention are explained referring to attached drawings.

[0015] Fig. 1 is a cross-sectional view showing a structure of a pump device 10 according to a first em-

bodiment of the present invention. The pump device 10 may be employed in a vehicle, for example, to a water pump for circulating a fluid (coolant water in this case) between an engine and a radiator (not shown) in an engine room, an oil pump for supplying a fluid for lubrication (oil in this case) to the engine, and the like. The pump device 10 is electrically driven.

[0016] The pump device 10 includes a pump housing 11 made of metal and a motor housing 12 made of resin, which constitute an outer form of the pump device 10. The pump housing 11 includes a fluid chamber 15 to which the fluid is supplied, an intake port 11a through which the fluid is inhaled to flow into the fluid chamber 15, and a discharge port 15c through which the fluid in the fluid chamber 15 is highly pressurized and discharged outside of the pump device 10. In addition, the pump housing 11 includes an opening for leading a part of the fluid at a portion 32 where the fluid is highly pressurized (high pressure portion). A bearing plate 13 made of resin is disposed between the pump housing 11 and the motor housing 12, covering the opening of the pump housing 11 from an axial direction, thereby assuring a sealing performance between the pump housing 11 and the bearing plate 13.

[0017] The bearing plate 13 includes a bearing bore 13a and a second bearing portion 13b at a center portion in a radial direction of the bearing plate 13. The second bearing portion 13b has a diameter smaller than the bearing bore 13a. A shaft 21 having a large diameter portion and a small diameter portion is inserted into the bearing bore 13a from an axial direction. An end portion of the small diameter portion of the shaft 21 projects into a center of the fluid chamber 15 formed within the pump housing 11 under the condition that the small diameter portion of the shaft 21 is rotatably supported by the second bearing portion 13b.

[0018] The shaft 21 is a part of a member of a motor 20 (to be mentioned later) provided opposite side of the fluid chamber 15 relative to the bearing plate 13. One end of the shaft 21 on the motor 20 side is rotatably supported on a concave portion formed at a center of the motor housing 12. Meanwhile, an impeller 16 is assembled in a press fit manner to the other end of the shaft 21 on the pump housing 11 side that extends to the fluid chamber 15. The impeller 16 is of a substantially circular shape when viewed from the intake port 11a side and integrally formed with a plurality of blades 16a at an outer periphery in a peripheral direction.

[0019] The fluid chamber 15 includes a first fluid chamber 15a continuously connected to the intake port 11a having a cylindrical shape and a second fluid chamber 15b (high pressure portion) formed on outer diameter side of the fluid chamber 15 relative to the first fluid chamber 15a and highly pressurized as compared to the first fluid chamber 15a when the pump device 10 is operated. At this time, the discharge port 15c through which the fluid is discharged is arranged on a plane perpendicular to the intake port 11a through which the fluid

is inhaled and also formed at a portion where the fluid is highly pressurized and discharged by the rotation of the impeller 16.

[0020] A structure of the motor 20 is explained as follows. The motor housing 12 includes a concave portion in which a core 24 formed by plurality of annularly-shaped metallic laminated sheets are arranged. In addition, a coil 23 is wound on the core 24. The core 24 with the coil 23 wound thereon arranged within the concave portion forms a stator of the motor 20. A surface of the concave portion where the stator is arranged is molded by resin.

[0021] The shaft 21 made of cylindrical-shaped metal includes small diameter portions 21a and 21c at both ends of the shaft 21, having the same diameter as each other. A large diameter portion 21b is disposed between the small diameter portions 21a and 21c so as to be integrally formed therewith. The large diameter portion 21b faces to an inner diameter portion of the annular core 24 with keeping a predetermined distance therebetween. A magnet 22 (rotor) having a cylindrical shape is attached to the large diameter portion 21b. The magnet 22 is a four-pole magnet in which north poles and south poles are alternately arranged in a peripheral direction at an outer periphery of the large diameter portion 21b of the shaft 21. The magnet 22 is fixed to the large diameter portion 21b by an adhesive means such as an adhesive agent and a strong adhesive tape so that the magnet 22 rotates as a unit with the shaft 21.

[0022] The small diameter portion 21c of the shaft 21 is rotatably supported by a first bearing portion 12b formed at a center in the radial direction of the concave portion of the motor housing 12. The small diameter portion 21a penetrates through the bearing bore 13a of the bearing plate 13, projecting into the fluid chamber 15. The impeller 16 is assembled to a tip end portion of the projected small diameter portion 21a. In this case, a bush is preferably insert-molded to the first bearing portion 12b for smoothening the rotation of the shaft 21 by improving a coaxiality of the shaft 21 by the first bearing portion 12b and the second bearing portion 13b of the bearing plate 13.

[0023] A fluid passage through which the fluid flows is explained as follows. A gap 12t is formed between an inner wall 12a of the motor housing 12 and an end portion in the axial direction of the magnet 22. In addition, a slit-shaped gap 12s extending in the radial direction is formed on a surface of the concave portion between an end portion in the axial direction of the large diameter portion 21b and the inner wall 12a of the motor housing 12 being molded. Further, respective small gaps are formed between an inner diameter of the bearing bore 13a of the bearing plate 13 and an outer periphery of the small diameter portion 21a, and between an axially end face of the bearing bore 13a on the motor 20 side and an axially end face of the large diameter portion 21b on the pump housing 11 side. The shaft 21 is supported by both the bearing plate 13 and the motor housing 12

via the bearing portions 13b and 12b, respectively.

[0024] The sealing performance between contact faces of the motor housing 12 and the bearing plate 13 is assured by an O-ring 25. In addition, the sealing performance between the pump housing 11 and the bearing plate 13 is assured by putting an annular plate therebetween. Then, the pump housing 11, the bearing plate 13 and the motor housing 12 are fixed to each other at several positions via a plurality of tightening members 19.

[0025] A feed port 31a (opening) for leading a part of the fluid with a high pressure into the inner diameter side of the bearing plate 13 is opened in the second fluid chamber 15b in which the fluid pressure is higher than the first fluid chamber 15a, and extending into the bearing plate 13. In addition, a fluid passage 31 (first fluid passage) extends obliquely from the second fluid chamber 15b to the second bearing portion 13b and the bearing bore 13a towards the small diameter portion 21a of the shaft 21 within the bearing plate 13 in a state of communicating with the feed port 31a. In this case, the fluid passage 31 is formed, avoiding a portion where the O-ring 25 is provided for sealing the motor housing 12 and the bearing plate 13. The fluid passage 31 is formed as a bore extending obliquely towards the shaft 21 in the bearing plate 13 or a bore extending from a position of the feed port 31a in the axial direction (thickness direction) of the bearing plate 13 and being connected to a bore formed from a stepped portion positioned at an opposite side relative to the shaft 21 of the bearing plate 13 (i.e. end portion of the motor housing 12 on the pump housing 11 side) in the oblique direction. The fluid passage 31 may be formed by penetrating through both side faces in the axial direction of the bearing plate 13, thereby achieving a simple structure. The fluid flows through the fluid passage 31 from the feed port 31a to the second bearing portion 13b for lubrication and/or cooling of the second bearing portion 13b. In this case, a part of the fluid from the feed port 31a is supplied to the gap formed between the bearing bore 13a and the small diameter portion 21a, and then to the outer periphery of the shaft 21 from the bearing bore 13a via the gap formed between the outer periphery of the magnet 22 and the inner wall 12a. In addition, a part of the fluid being highly pressurized is supplied to the first bearing portion 12b of the shaft 21.

[0026] An end portion of the fluid passage 31 communicating with the feed port 31a and formed in the oblique direction within the bearing plate 13 is blocked by an end portion of the inner diameter portion of the motor housing 12 in which the stator is provided. The fluid hitting the end portion of the fluid passage 31 being blocked is prevented from flowing in the oblique direction. Thus, the fluid is diverted to flow into the gap formed between the bearing bore 13a and the small diameter portion 21a and then supplied to the outer periphery of the shaft 21. Finally, the fluid is supplied to an axially end portion of the shaft 21 within the first bearing portion 12b. In this case, an existence of foreign matter in the

fluid supplied to the shaft 21 may cause a rotation failure of the shaft 21. Thus, a filter 38 is provided at the feed port 31a in order to prevent the foreign matter from entering into the fluid passage 31.

[0027] An operation of the pump device 10 is explained as follows.

[0028] When the coil 23 is energized by a controller (not shown) that drives the pump device 10, the pump device 10 starts driving. An excitation to the magnet 22 attached to the large diameter portion 21b of the shaft 21 is alternated by energizing the coil 23, thereby causing the shaft 21, to which the magnet 22 is fixed, to rotate integrally with the bearing portions 13b and 12b. The impeller 16 assembled to the shaft 21 rotates accordingly. Due to the rotation of the impeller 16, the fluid is supplied from the intake port 11a of the pump housing 11 and then flows into the first fluid chamber 15a. The fluid supplied to the first fluid chamber 15a is pressurized and sent to the second fluid chamber 15b provided on the outer diameter side relative to the first fluid chamber 15a. Afterwards, the fluid is discharged from the discharge port 15c provided in the second fluid chamber 15b of the pump housing 11 to the outside of the pump device 10 (for example, engine and the like in case of the vehicle). According to the above-mentioned flow of the fluid, the pump function of the pump device 10 may be obtained.

[0029] According to the aforementioned embodiment, a part of the fluid in the second fluid chamber 15b being pressurized and sent from the first fluid chamber 15a by the rotation of the impeller 16, i.e. the fluid in the vicinity of the feed port 31a with a higher pressure than the intake port 11a, flows into the fluid passage 31 via the feed port 31a. The fluid flowing into the fluid passage 31 is pressurized and sent to the bearing bore 13a, and also supplied to the second bearing portion 13b by the rotation of the impeller 16. The fluid passage 31 extends further in the oblique direction via the inner diameter of the bearing bore 13a. However, the end portion of the fluid passage 31 formed in the oblique direction is blocked with the end portion of the inner diameter portion of the motor housing 12. Therefore, the fluid reaching the gap formed between the bearing bore 13a and the shaft 21 flows along the axial direction of the shaft 21 into the gap formed between the magnet 22 and the inner wall 12a molding the stator. In this case, a slit is formed in the axial direction on the inner diameter portion of the second bearing portion 13b. In addition, a plurality of slits 13s are formed in the radial direction on an end portion of the bearing bore 13a on the motor 20 side. Thus, the fluid in the fluid passage 31 smoothly flows through the outer periphery of the small diameter portion 21a of the shaft 21 and the gap formed between the outer periphery of the magnet 22 and the inner wall 12a. The fluid then flows along the outer periphery of the small diameter portion 21c of the shaft 21 and led to the first bearing portion 12b to which the shaft 21 is rotatably supported.

[0030] A fluid passage 21p (third fluid passage) for letting the fluid flow into the first fluid chamber 15a on the intake side is formed within the shaft 21, axially penetrating through a center portion of the shaft 21. In this case, an escape bore 16b for letting the fluid led from the fluid passage 21p flow into the first fluid chamber 15a is formed at a tip end portion of the impeller 16 assembled to the tip end portion of the shaft 21. Therefore, the fluid reaching the first bearing portion 12b flows through the fluid passage 21p formed within the shaft 21 and the escape bore 16b of the impeller 16, and then ultimately returns to the first fluid chamber 15a.

[0031] A process of a part of the fluid in the second fluid chamber 15b flowing through the feed port 31a, the fluid passage 31, and the like and then returning to the first fluid chamber 15a has been explained. Focusing on a pressure balance between the first fluid chamber 15a and the second fluid chamber 15b, the pressure in the second fluid chamber 15b is higher than that of the first fluid chamber 15a when the pump is driven since the fluid in the first fluid chamber 15a is pressurized and then sent to the second fluid chamber 15b by the rotation of the impeller 16. Therefore, the fluid flows smoothly from the feed port 31a provided in the second fluid chamber 15b through the fluid passage 31, the inside of the motor 20, and then to the first fluid chamber 15a.

[0032] According to the above-mentioned structure, an original function of the fluid passage that the fluid is pressurized and sent to a required portion within the motor 20 for lubrication and/or cooling may not be deteriorated by forming the fluid passage 31 within the bearing plate 13 in the oblique direction with avoiding a portion where the O-ring 25 is provided. Further, the foreign matter included in the fluid that circulates through the inside of the pump device 10 is surely eliminated by the filter 38 provided on the high-pressure side. As a result, a high lubricity may be obtained, thereby improving the reliability of the pump device 10.

[0033] A second embodiment of the present invention is explained referring to Fig. 2. A structure of the second embodiment is basically same as that of the first embodiment but differs in a method how the highly pressurized fluid is led to the bearing portion of the shaft 21 and then returned to the intake side. Therefore, the same structure as the first embodiment is omitted and a different structure only is explained as follows.

[0034] According to the second embodiment, the fluid passage 31 is not formed within the bearing plate 13. Instead, a fluid passage 33 (first fluid passage) is formed within the impeller 16.

[0035] The impeller 16 made of resin is insert-molded by a bush 17 made of metal being inserted into a center of the impeller 16. The impeller 16 includes the plurality of blades 16a and a base portion 16c for supporting the blades 16a. The fluid passage 33 is formed in the base portion 16c of the impeller 16, extending in the radial direction of the impeller 16. The fluid passage 33 penetrates into the bush 17. The fluid passage 33 communi-

cates with the second fluid chamber 15b with a higher pressure than the intake port 11a. A filter 35 for preventing the foreign matter from entering into the fluid passage 33 is provided on an outer diameter side thereof.

[0036] A fluid passage 36 (second fluid passage) is formed within the shaft 21 in the radial direction so as to communicate with the fluid passage 33 formed within the impeller 16. At the same time, a fluid passage 37 (second fluid passage) is formed in a center portion of the shaft 21, extending in the axial direction thereof from an end portion of the first bearing portion 12b so as to communicate with the fluid passage 36.

[0037] According to the aforementioned structure of the second embodiment, a part of the fluid that is highly pressurized by the rotation of the impeller 16 flows through the fluid passage 33 after passing through the filter 35, thereby preventing the foreign matter from entering into the fluid passage 33 formed within the impeller 16. Then, the fluid is supplied from the axially center portion of the shaft 21 to the first bearing portion 12b via the fluid passages 36 and 37. The fluid is then supplied around the shaft 21 and the inner wall 12a of the motor 20, thereby achieving the lubrication and/or cooling within the motor 20 including the shaft 21. In this case, the fluid is supplied to the outer periphery of the shaft 21, the inner wall 12a of the motor 20, and the bearing portions 12b and 13b via the gaps shown in the first embodiment. The fluid led to the second bearing portion 13b flows into a penetrating bore 16d penetrating through both sides in the axial direction of the base portion 16c, then into the first fluid chamber 15a on the intake side of the fluid chamber 15. Thus, an extra piping is not required to be employed. Further, a labyrinth L is formed between the base portion 16c and the bearing plate 13 on a radially outward side relative to the penetrating bore 16d, thereby effectively leading the fluid from the second bearing portion 13b to the first fluid chamber 15a.

[0038] According to the above-mentioned structure, the effective cooling and/or lubrication may be achieved. The filter 35 is provided at a feed port for the fluid and thus the foreign matter may be caught by the filter 35. The filter 35 is provided on the outer peripheral portion of the impeller 16, so that the foreign matter may be blown outside of the impeller 16 due to centrifugal force occurring when the impeller 16 rotates even if the foreign matter exists on the outer diameter portion of the impeller 16. The foreign matter is prevented from accumulating on a surface of the filter 35. Therefore, the bearing portions 13b and 12b to which the shaft 21 is rotatably supported for rotating the impeller 16 may be protected by a simple structure of providing the filter 35 at the feed port of the impeller 16.

[0039] With the shaft 21 made of metal being employed in the structure of Fig. 2, the magnetic foreign matter included in the fluid and passing through the filter 35 may be caught by the magnetic force of the magnet 22 fixed to the shaft 21 when the fluid flows through the

axially center portion of the shaft 21. In addition, the fluid passages 36 and 37 each having a uniform diameter in the axial direction may be provided with a reduced diameter portion.

[0040] According to the aforementioned first embodiment, one end of the fluid passage 31 is formed with the opening facing the fluid chamber 15. The other end of the first fluid passage 31 is provided adjacent to the second bearing portion 13b and communicates with the bearing bore 13a having a larger diameter than the second bearing portion 13b. Thus, the fluid may be led from the fluid chamber 15 to the bearing portions 12b and 13b via the bearing bore 13a. Further, the opening is provided in the second fluid chamber 15b in which the fluid has a high pressure in the pump housing 11. Thus, a part of the fluid may be led to the opening, being pressurized and sent to the lubricant portion.

[0041] Further, according to the aforementioned first embodiment, the filter 38 is provided at the feed port 31a for leading the fluid to the fluid passage 31. Thus, the foreign matter from the fluid chamber 15 is prevented from being mixed into the fluid and reaching the shaft 21. The malfunction of the pump device 10 due to entering of the foreign matter may be avoided.

[0042] Furthermore, according to the aforementioned first embodiment, the fluid passage 31 may penetrate through the both side faces of the bearing plate 13 in the axial direction, thereby obtaining the fluid passage 31 with a simple structure.

[0043] Furthermore, according to the aforementioned first embodiment, the first bearing portion 12b and the second bearing portion 13b communicate with each other via a gap formed between the stator of the motor 20 and the magnet 22, thereby cooling the stator and the magnet 22.

[0044] Furthermore, according to the aforementioned first embodiment, the fluid passage 21p is formed within the shaft 21 for connecting the first bearing portion 12b and the first fluid chamber 15a on the intake side. Thus, the fluid supplied to the first bearing portion 12b may easily flow by using the intake pressure of the first fluid chamber 15a.

[0045] Furthermore, according to the aforementioned first embodiment, the end portion of the bearing bore 13a on the motor 20 side is formed with a slit in the radial direction of the shaft 21. Thus, the fluid may smoothly flow through the gap formed between the bearing bore 13a and the shaft 21.

[0046] Furthermore, according to the aforementioned first embodiment, the fluid passage 31 formed within the bearing plate 13 and extending in the radial direction thereof keeps a predetermined angle with the shaft 21. Thus, the fluid passage 31 may be formed with a simple structure.

[0047] Furthermore, according to the aforementioned second embodiment, the fluid passages 36 and 37 communicating with the fluid passage 33 and leading the fluid to the first bearing portion 12b is formed in the shaft

21. Thus, an extra piping is not required to be provided outside of the pump device 10 for leading the fluid to the first bearing portion 12b.

[0048] Furthermore, according to the aforementioned second embodiment, the fluid passage 33 is formed in the base portion 16c for supporting the blades 16a of the impeller 16. Thus, the bearing portions 12b and 13b may be protected with high space efficiency by using the base portion 31c not having a feature of moving the fluid.

[0049] Furthermore, according to the aforementioned second embodiment, the penetrating bore 16d is formed on the base portion 16c for penetrating through the both sides of the base portion 16c. Thus, an extra piping for leading the fluid to the first fluid chamber 15a is not required.

[0050] Furthermore, according to the aforementioned second embodiment, the fluid flowing through the fluid passage 33 is led to the first fluid chamber 15a on the intake side of the fluid chamber 15 via the fluid passages 36 and 37, the first bearing portion 12b, the gap between the stator and the magnet 22, the second bearing portion 13b formed at the bearing plate 13 disposed between the pump housing 11 and the motor housing 12 and rotatably supporting the shaft 21, the gap formed between the bearing plate 13 and the base portion 13c, and the penetrating bore 16d. Thus, the lubrication and cooling of each bearing portion 12b and 13b, the stator and the magnet 22 may be performed with a short piping.

[0051] Furthermore, according to the aforementioned second embodiment, the labyrinth L is formed between the base portion 16c and the bearing plate 13. Thus, the fluid may be effectively supplied to the first fluid chamber 15a.

[0052] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A pump device (10) comprising a pump housing (11) including a fluid chamber (15) for inhaling a fluid flowing through the fluid chamber via an intake port (11a) and discharging the fluid to an outside via a discharge port (15c), a motor housing (12) including a stator (23, 24), a shaft (21) whose one end projects into the pump housing and to which an im-

PELLER (16) IS ASSEMBLED, AND WHOSE THE OTHER END IS ROTATABLY CONNECTED TO A FIRST BEARING PORTION (12b) WITHIN THE MOTOR HOUSING, A ROTOR (22) ASSEMBLED TO THE SHAFT AND FACING THE STATOR, AND A BEARING PLATE (13) DISPOSED BETWEEN THE PUMP HOUSING AND THE MOTOR HOUSING AND INCLUDING A SECOND BEARING PORTION (13b) ROTATABLY SUPPORTING THE SHAFT **CHARACTERIZED IN THAT** THE BEARING PLATE IS FORMED BY A FIRST FLUID PASSAGE (31) FOR LEADING THE FLUID TO INSIDE OF THE BEARING PLATE.

2. A pump device according to claim 1, wherein the first fluid passage includes a first end including an opening (31a) facing the fluid chamber and a second end communicating with a bearing bore (13a) formed at the bearing plate and provided adjacent to the second bearing portion and having a larger diameter than the second bearing portion.

3. A pump device according to claim 2, wherein the opening is provided in a second fluid chamber (15b) having a high fluid pressure in the pump housing.

4. A pump device according to claim 2 or 3, wherein the opening includes a filter (38).

5. A pump device according to any of claims 1 to 4, wherein the first fluid passage penetrates through both side faces of the bearing plate in an axial direction.

6. A pump device according to any of claims 1 to 5, wherein the first bearing portion and the second bearing portion communicate with each other via a gap formed between the stator and the rotor.

7. A pump device according to any of claims 1 to 6, wherein the shaft includes a fluid path (21p) for connecting the second bearing portion and a first fluid chamber (15a) provided on an intake side of the fluid chamber.

8. A pump device according to claim 2, wherein a side end portion of the bearing bore on the motor side is formed by a slit (13s) in a radial direction of the shaft.

9. A pump device according to any of claims 1 to 8, wherein the first fluid passage formed in the bearing plate and extending in a radial direction thereof keeps a predetermined angle with the shaft.

10. A pump device (10) comprising a pump housing (11) including a fluid chamber (15) for inhaling a fluid flowing through the fluid chamber via an intake port (11a) and discharging the fluid to an outside via a discharge port (15c), a motor housing (12) including a stator (23, 24), a shaft (21) whose one end

PROJECTS INTO THE PUMP HOUSING AND TO WHICH AN IMPELLER (16) IS ASSEMBLED, AND WHOSE OTHER END IS ROTATABLY CONNECTED TO A FIRST BEARING PORTION (12b) WITHIN THE MOTOR HOUSING, AND A ROTOR (22) ASSEMBLED TO THE SHAFT AND FACING THE STATOR **CHARACTERIZED IN THAT** THE IMPELLER IS FORMED WITH A FIRST FLUID PASSAGE (33) EXTENDING IN A RADIAL DIRECTION OF THE IMPELLER FOR LEADING THE FLUID TO THE FIRST BEARING PORTION.

11. A pump device according to claim 10, wherein the shaft includes a second fluid passage (37) communicating with the first fluid passage and leading the fluid to the first bearing portion.

12. A pump device according to claim 10 or 11, wherein the first fluid passage includes a feed port to which the fluid is led and at which a filter (35) is provided.

13. A pump device according to any of claims 10 to 12, wherein the first fluid passage is formed in a base portion (16c) of the impeller for supporting a blade (16a) of the impeller.

14. A pump device according to claim 13, wherein the base portion includes a penetrating bore (16d) penetrating through both sides of the base portion in an axial direction thereof.

15. A pump device according to claim 14, wherein the fluid supplied from the first fluid passage is led to a first fluid chamber (15a) on an intake side of the fluid chamber via the second fluid passage, the first bearing portion, a gap formed between the stator and the rotor, a second bearing portion (13b) formed at a bearing plate (13) disposed between the pump housing and the motor housing and rotatably supporting the shaft, a gap formed between the bearing plate and the base portion, and the penetrating bore.

16. A pump device according to claim 15, further comprising a labyrinth (L) formed between the base portion and the bearing plate radially outside of the penetrating bore.

FIG. 1

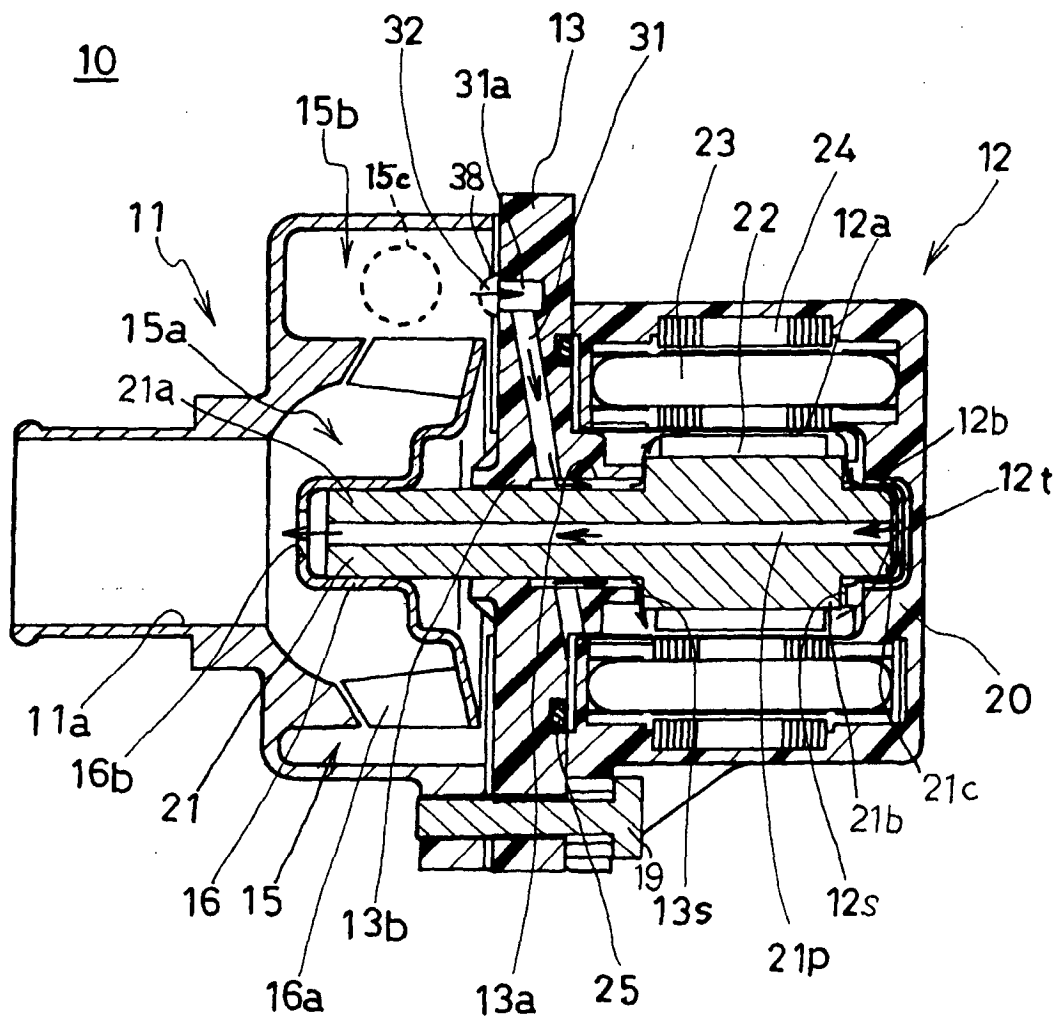


FIG. 2

