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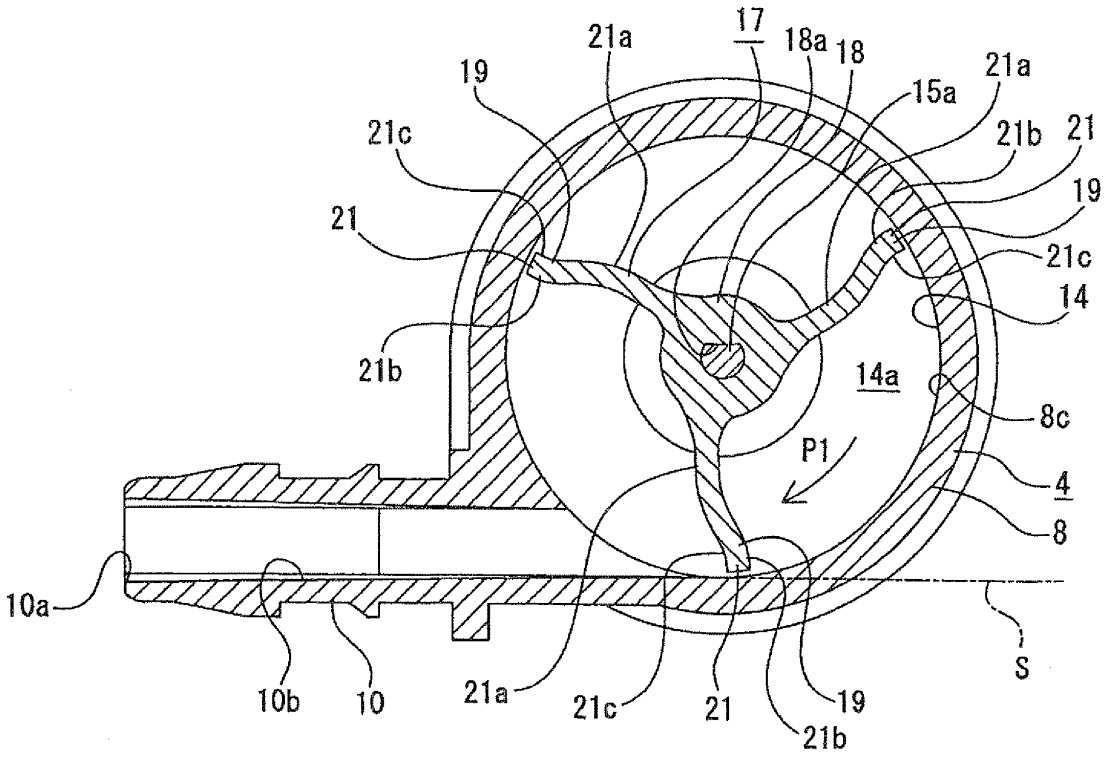
(54) Motor pump

(57) A motor pump includes : a case having a cavity; a suction pipe; an ejection pipe; a drive motor; and an impeller fixed to a drive shaft of the drive motor, wherein the impeller includes a bearing portion configured to be fixed to the drive shaft and blade portions protruding in radial direction from the bearing portion, wherein each of the blade portions includes a base portion formed to continue from the bearing portion and a tip portion formed to continue from the base portion, wherein the base portion of each of the blade portions is formed to be convexly curved toward a rotational direction of the impeller, and wherein the tip portion of each of the blade portions is formed to be convexly curved toward a backward direction opposite the rotational direction.

FIG. 3



EP 2 236 835 A1

Description

CROSS REFERENCE TO RELATED APPLICATION(S)

[0001] The present disclosure relates to the subject matters contained in Japanese Patent Application No. 2009-074012 filed on December 25, 2009, which are incorporated herein by reference in its entirety.

BACKGROUND

1. Field

[0002] The present invention relates to a motor pump.

2. Description of the Related Art

[0003] Conventionally, there is a headlamp cleaner having a part moved to be taken in and out from an opening formed on a vehicle body or on a bumper to thereby clean a front cover of a vehicle headlamp.

[0004] The headlamp cleaner includes a spray nozzle for ejecting cleaning liquid, and a cylinder having a supply pipe. Cleaning liquid supplied to the cylinder through the supply pipe is ejected from the spray nozzle toward the front cover of the vehicle headlamp to thereby clean the front cover.

[0005] Cleaning liquid is supplied to the cylinder by a motor pump. A drive motor having a drive shaft is disposed inside the motor pump. A suction pipe as a suction path for suctioning the cleaning liquid and an ejection pipe as a ejection path for feeding the suctioned cleaning liquid are provided in the motor pump. The suction pipe is connected to a tank while the ejection pipe is connected to the supply pipe of the cylinder by a hose.

[0006] An impeller for performing suction and discharge of cleaning liquid is rotatably supported inside the motor pump. While cleaning liquid is suctioned from the tank into the motor pump, the cleaning liquid is fed from the motor pump to the cylinder in accordance with rotation of the impeller.

[0007] In the motor pump of the type described in the above, the impeller has a bearing portion connected to the drive shaft of the drive motor, and blade portions protruding from an outer circumferential surface of the bearing portion. An example of such configuration is disclosed in JP-A-2006-299898.

[0008] In the configuration disclosed in JP-A-2006-299898, each of the blade portions provided in the impeller of the motor pump is shaped to have a curve which is displaced gradually between a direction of rotation of the impeller and a direction opposite thereto in a range of from the bearing portion to a tip of the blade portion.

[0009] In the motor pump disclosed in JP-A-2006-299898, the pressure of each blade portion for pressing cleaning liquid to the ejection pipe side may become so low that liquid pressure for feeding the cleaning liquid may hardly be kept high, since each blade portion of the impeller is shaped to have a curve which is displaced gradually between a direction of rotation of the impeller and a direction opposite thereto in a range of from the bearing portion to the tip as described above.

[0010] Moreover, because the liquid pressure may hardly be kept high, there is also a disadvantage that the volume per unit time of cleaning liquid fed to the cleaner is small.

SUMMARY

[0011] One of objects of the present invention is to provide a motor lamp for a headlamp cleaner capable to increase flow rate of cleaning liquid and to improve liquid pressure for feeding the cleaning liquid.

[0012] According to an aspect of the invention, there is provided a motor pump including: a case having a cavity having an inner circumferential surface, the cavity being configured to temporary store liquid being suctioned therein; a suction pipe provided to serve as a suction path for suctioning the liquid into the cavity, the suction pipe having one end being provided with an inlet and the other end communicating with the cavity; an ejection pipe provided to serve as an ejection path for ejecting the liquid from the cavity, the ejection pipe having one end being provided with an outlet and the other end communicating with the cavity; a drive motor disposed inside the case, the drive motor having a drive shaft; and an impeller fixed to the drive shaft to be rotated inside the cavity and the suction pipe to suction and eject the liquid, wherein the impeller includes a bearing portion configured to be fixed to the drive shaft and blade portions protruding in radial direction from the bearing portion, wherein each of the blade portions includes a base portion formed to continue from the bearing portion and a tip portion formed to continue from the base portion, wherein the base portion of each of the blade portions is formed to be convexly curved toward a rotational direction of the impeller, and wherein the tip portion of each of the blade portions is formed to be convexly curved toward a backward direction opposite the rotational direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] A general configuration that implements the various feature of the invention will be described with reference to the drawings. The drawings and the associated descriptions are provided to illustrate embodiments of the invention and not to limit the scope of the invention.

Fig. 1 is a perspective view of a motor pump showing an example of a motor pump of a headlamp cleaner according to the invention.

Fig. 2 is a sectional view of the motor pump.

Fig. 3 is an enlarged sectional view taken along the III-III line shown in Fig. 2.

Fig. 4 is an enlarged perspective view of an impeller.
Fig. 5 is a schematic view showing the shape of each blade portion in the impeller.

DETAILED DESCRIPTION OF THE EMBODIMENT(S)

[0014] An embodiment according to the present invention will be described in detail with reference to the accompanying drawings. The scope of the claimed invention should not be limited to the examples illustrated in the drawings and those described below.

[0015] As shown in Figs. 1 and 2, a motor pump 1 has a case 2 and other components disposed inside the case 2.

[0016] The case 2 is configured by an upper-half case 3 and a lower-half case 4 which are combined vertically.

[0017] The upper-half case 3 is opened downward and has a cylindrical wall 5 having a cylindrical shape, and a top wall 6 formed to be continued from an upper edge of the cylindrical wall 5 so as to cover one end of the cylindrical wall 5.

[0018] The cylindrical wall 5 has a fitting groove 5a and a fitting protrusion 5b which are formed vertically and continuously so as to be located near a lower end of the cylindrical wall 5.

[0019] The top wall 6 is integrally provided with a connector portion 7 which protrudes upward from an upper surface of the top wall 6. A connection terminal 7a is disposed inside the connector portion 7. A not-shown power connector for supplying electric power to a drive motor, which will be described later, is connected to the connection terminal 7a.

[0020] The lower-half case 4 is opened upward and has a cylindrical wall 8 formed to have a cylindrical shape, and a top wall 9 formed to be continued from a lower end portion of the cylindrical wall 8 so as to cover the lower end portion of the cylindrical wall 8.

[0021] The cylindrical wall 8 has a fitting protrusion 8a and a fitting groove 8b which are formed vertically and continuously so as to be located near an upper end of the cylindrical wall 8. The cylindrical wall 8 is integrally provided with an ejection pipe 10 which protrudes laterally from a lower end portion of the cylindrical wall 8. The ejection pipe 10 has one end (tip) at which an outlet 10a is formed, and the other end which communicates with a cavity (which will be described later) formed inside the case 2.

[0022] The top wall 9 is integrally provided with a suction pipe 11 which protrudes downward from a center portion of the top wall 9. The suction pipe 11 has one end (lower end) at which an inlet 11a is formed, and the other end which communicates with the cavity formed inside the case 2.

[0023] As shown in Fig. 2, the upper-half case 3 and the lower-half case 4 are combined with each other to form the case 2 in such a manner that the fitting protrusion 8a is fitted into the fitting groove 5a while the fitting protrusion 5b is fitted into the fitting groove 8b.

[0024] A spacer 12 is disposed inside the lower-half case 4 so as to be fitted to the lower-half case 4. A shaft insertion hole 12a is formed in a center portion of the spacer 12 so as to pierce the spacer 12 vertically. Because the spacer 12 is disposed inside the lower-half case 4, an upper space 13 and a lower space 14 are formed as upper and lower parts respectively inside the case 2.

[0025] A drive motor 15 is disposed in the upper space 13. The drive motor 15 is configured by drive coils and drive magnets. The drive motor 15 has a drive shaft 15a which is formed in a center portion of the drive motor 15 so as to extend vertically. A part of the drive shaft 15a protrudes downward.

[0026] A rubber bush 16 is disposed in the lower space 14 so as to be located under the spacer 12. The rubber bush 16 is fitted inside the lower-half case 4 and has a shaft support hole 16a which is disposed in a center portion of the rubber bush 16 so as to pierce the rubber bush 16 vertically. The rubber bush 16 has a function of preventing cleaning liquid (which will be described later) from leaching out from the lower space 14 into the upper space 13.

[0027] The downward protruding part of the drive shaft 15a of the drive motor 15 is formed as follows. The drive shaft 15a is inserted into the shaft insertion hole 12a of the spacer 12 and passes through the shaft support hole 16a of the rubber bush 16 so as to be supported by the shaft support hole 16a of the rubber bush 16. As a result, a lower end portion of the drive shaft 15a protrudes downward from the rubber bush 16.

[0028] A portion of the lower case space 14 which is surrounded by an inner circumferential surface 8c of the cylindrical wall 8, a lower surface of the rubber bush 16 and an inner surface of the top wall 9 in the lower-half case 4 is formed as a cavity 14a in which cleaning liquid can be stored temporarily. The other end of the ejection pipe 10 and the other end of the suction pipe 11 communicate with the cavity 14a.

[0029] An impeller 17 is disposed inside the cavity 14a and the suction pipe 11 so as to be supported rotatably (see Figs. 2 and 3). As shown in Figs, 2 to 4, the impeller 17 is formed in such a manner that a bearing portion 18 is integrated with blade portions 19, 19 and 19 protruding in radial direction from the bearing portion 18.

[0030] A fixing hole 18a opened upward is formed in the bearing portion 18.

[0031] The blade portions 19, 19 and 19 are provided and positioned at regular intervals in a circumferential direction around the bearing portion 18. Each of the blade portions 19, 19 and 19 is configured by a suction blade 20 protruding downward from the bearing portion 18 and a feed blade 21 protruding laterally from the bearing portion 18.

[0032] Each feed blade 21 is configured by a base portion 21a continued to the bearing portion 18 and a tip portion 21b continued to the base portion 21a. The length of each base portion 21a in a laterally extending direction

is set to be larger than that of a corresponding tip portion 21b.

[0033] As shown in Figs. 3 and 5, each base portion 21a is shaped to have a gentle curve such as a substantially circular arc which is convexly curved toward a direction of rotation of the impeller 17 (a direction P1 shown in Figs. 3 to 5). As shown in Figs. 3 and 5, each tip portion 21b is shaped to have a gentle curve such as a substantially circular arc which is convexly curved toward a direction opposite to the direction P1 of rotation of the impeller 17.

[0034] In the impeller 17, the base portions 21a, 21a and 21a are shaped like circular arcs so that three reference lines T, T and T radiating at regular intervals from a center M of the bearing portion 18 are tangential to extensions Q, Q and Q of the base portions 21a, 21a and 21a at the center M. Accordingly, cleaning liquid can be prevented from staying stagnantly in the vicinity of bearing portion 18-side end portions of the base portions 21a, 21a and 21a, so that improvement in fluidity of cleaning liquid can be improved.

[0035] The impeller 17 is fixed in such a manner that a lower end portion of the drive shaft 15a of the drive motor 15 is inserted into the fixing hole 18a of the bearing portion 18. The bearing portion 18 and the feed blades 21, 21 and 21 are disposed in the cavity 14a while the suction blades 20, 20 and 20 are disposed inside the suction pipe 11. Accordingly, the impeller 17 is rotated inside the cavity 14a and the suction pipe 11 by driving force of the drive motor 15.

[0036] In a state that the impeller 17 is disposed inside the cavity 14a and the suction pipe 11, respective tips (outer ends) of the feed blades 21, 21 and 21 are located near the inner circumferential surface 8c of the lower-half case 4 forming the cavity 14a (see Fig. 3) while respective tips (outer ends) of the suction blades 20, 20 and 20 are located so that a predetermined gap is formed between the tip of each suction blade 20 and the inner surface of the suction pipe 11.

[0037] As shown in Fig. 3, the ejection pipe 10 is provided so that an axial direction of the ejection pipe 10 coincides with a direction tangential to the inner circumferential surface 8c, and that an outermost portion 10b of the inner surface of the ejection pipe 10 farthest from the center of rotation of the impeller 17 coincides with a line (S in Fig. 3) tangential to the inner circumferential surface 8c.

[0038] In the motor pump 1 configured as described above, when the drive motor 15 is rotated, the impeller 17 is rotated by driving force of the drive motor 15. When the impeller 17 is rotated, cleaning liquid is suctioned from a not-shown tank into the cavity 14a through the suction pipe 11 by the suction blades 20, 20 and 20 so that the suctioned cleaning liquid is fed to a not-shown cylinder of the headlamp cleaner through the ejection pipe 10 by the feed blades 21, 21 and 21. The cleaning liquid fed to the cylinder is ejected from a spray nozzle of the headlamp cleaner toward a front cover of a vehicle headlamp, so that the front cover is cleaned.

[0039] When cleaning liquid is fed from the cavity 14a toward the ejection pipe 10 in accordance with rotation of the impeller 17, cleaning liquid temporarily stored in the cavity 14a is forced out into the inside of the ejection pipe 10 by the feed blades 21, 21 and 21 rotating in the cavity 14a.

[0040] On this occasion, because the base portion 21a of each feed blade 21 is shaped to have a gentle curve which is convexly curved toward the direction of rotation of the impeller 17 as described above, flow resistance is so low that cleaning liquid can flow easily from the bearing portion 18 side to the tip portion 21b side, and that the flow rate of cleaning liquid increases as the cleaning liquid moves from the base portion 21a side to the tip portion 21b side.

[0041] Moreover, because the tip portion 21b of each feed blade 21 is shaped to have a gentle curve which is convexly curved toward a direction opposite to the direction of rotation of the impeller 17, the direction of a rotation-direction side surface 21c (see Fig. 3) of each tip portion 21b approaches a tangential line in the direction of rotation compared with the direction of a rotation-direction side surface of a corresponding base portion 21a. Accordingly, increase in flow rate of cleaning liquid and improvement in liquid pressure for feeding the cleaning liquid can be attained.

[0042] Moreover, because the tip portion 21b of each feed blade 21 is shaped to have a gentle curve which is convexly curved toward a direction opposite to the direction of rotation of the impeller 17, eddy currents of cleaning liquid which has flown from the base portion 21a side to the tip portion 21b side are adjusted so that velocity energy is efficiently converted into pressure energy in the vicinity of the tip portions 21b, 21b and 21b. Accordingly, increase in flow rate of cleaning liquid and improvement in liquid pressure for feeding the cleaning liquid can be attained.

[0043] Moreover, since the motor pump 1 is formed so that the respective tips of the feed blades 21, 21 and 21 in the impeller 17 are located near the inner circumferential surface 8c of the lower-half case 4 forming the cavity 14a, greater increase in flow rate of cleaning liquid in accordance with improvement in liquid pressure for feeding the cleaning liquid can be attained.

[0044] In addition, the motor pump 1 is formed so that the axial direction of the ejection pipe 10 coincides with a direction tangential to the inner circumferential surface 8c and that the portion 10b of the ejection pipe 10 coincides with a line tangential to the inner circumferential surface 8c. Accordingly, increase in flow rate of cleaning liquid and improvement in efficiency of liquid feeding operation can be attained.

[0045] The motor pump 1 is formed so that the impeller 17 is configured by three blade portions 19, 19 and 19. Because the number of the blade portions 19 is reduced to three as described above, resistance of cleaning liquid to the rotating impeller 17 can be reduced so that the

load imposed on the drive motor 15 can be reduced.

[0046] Since the number of the blade portions 19 is reduced to three, the volume of cleaning liquid in the cavity 14a can be increased.

[0047] However, the number of the blade portions 19 used in the impeller 17 of the motor pump 1 may not be limited to three. The number of the blade portions 19 may be chosen in accordance with a desired pump design.

[0048] In the above description, it is assumed that the motor pump 1 is used for a headlamp cleaner for ejecting the cleaning liquid to the headlamp of a vehicle. However, the motor pump 1 may be widely used for variety of vehicle lamps including the headlamp or may be widely used for window washer unit for ejecting the cleaning liquid toward a windshield of a vehicle.

[0049] Although the embodiment according to the present invention have been described above, the present invention is not limited to the above-mentioned embodiment but can be variously modified. Constituent components disclosed in the aforementioned embodiment may be combined suitably to form various modifications. For example, some of all constituent components disclosed in the embodiment may be removed or may be appropriately combined.

[0050] Additional advantages and modifications will readily occur to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details and representative embodiments shown and described herein. Accordingly, various modifications may be made without departing from the spirit or scope of the general inventive concept as defined by the appended claims and their equivalents.

Claims

1. A motor pump comprising:

a case having a cavity having an inner circumferential surface, the cavity being configured to temporary store liquid being suctioned therein;
a suction pipe provided to serve as a suction path for suctioning the liquid into the cavity, the suction pipe having one end being provided with an inlet and the other end communicating with the cavity;
an ejection pipe provided to serve as an ejection path for ejecting the liquid from the cavity, the ejection pipe having one end being provided with an outlet and the other end communicating with the cavity;
a drive motor disposed inside the case, the drive motor having a drive shaft; and
an impeller fixed to the drive shaft to be rotated inside the cavity and the suction pipe to suction and eject the liquid,

wherein the impeller comprises a bearing portion configured to be fixed to the drive shaft and blade portions protruding in radial direction from the bearing portion,
wherein each of the blade portions comprises a base portion formed to continue from the bearing portion and a tip portion formed to continue from the base portion,
wherein the base portion of each of the blade portions is formed to be convexly curved toward a rotational direction of the impeller, and
wherein the tip portion of each of the blade portions is formed to be convexly curved toward a backward direction opposite the rotational direction.

2. The motor pump according to Claim 1,
wherein the impeller is formed to have the tip portion of each of the blade portions being set to rotate near the inner circumferential surface of the cavity.

3. The motor pump according to one of Claims 1 and 2,
wherein an axial direction of the ejection pipe is set to coincide with a tangential direction of the inner circumferential surface of the cavity.

4. The motor pump according to one of claims 1 to 3,
wherein the cavity is formed to be surrounded by a cylindrical wall having the inner circumferential surface.

5. The motor pump according to one of claims 1 to 4,
wherein the impeller comprises three pieces of the blade portions.

FIG. 1

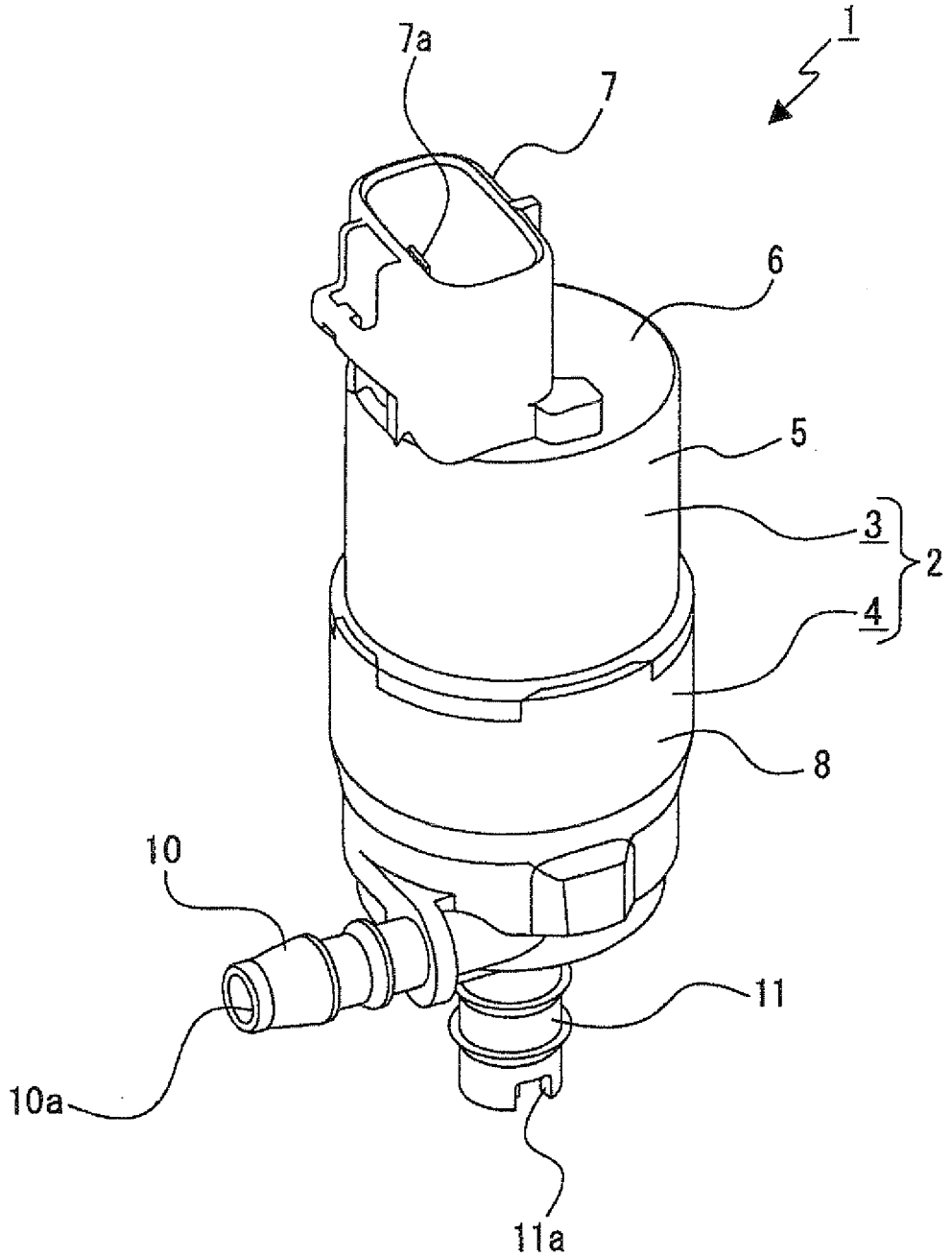


FIG. 2

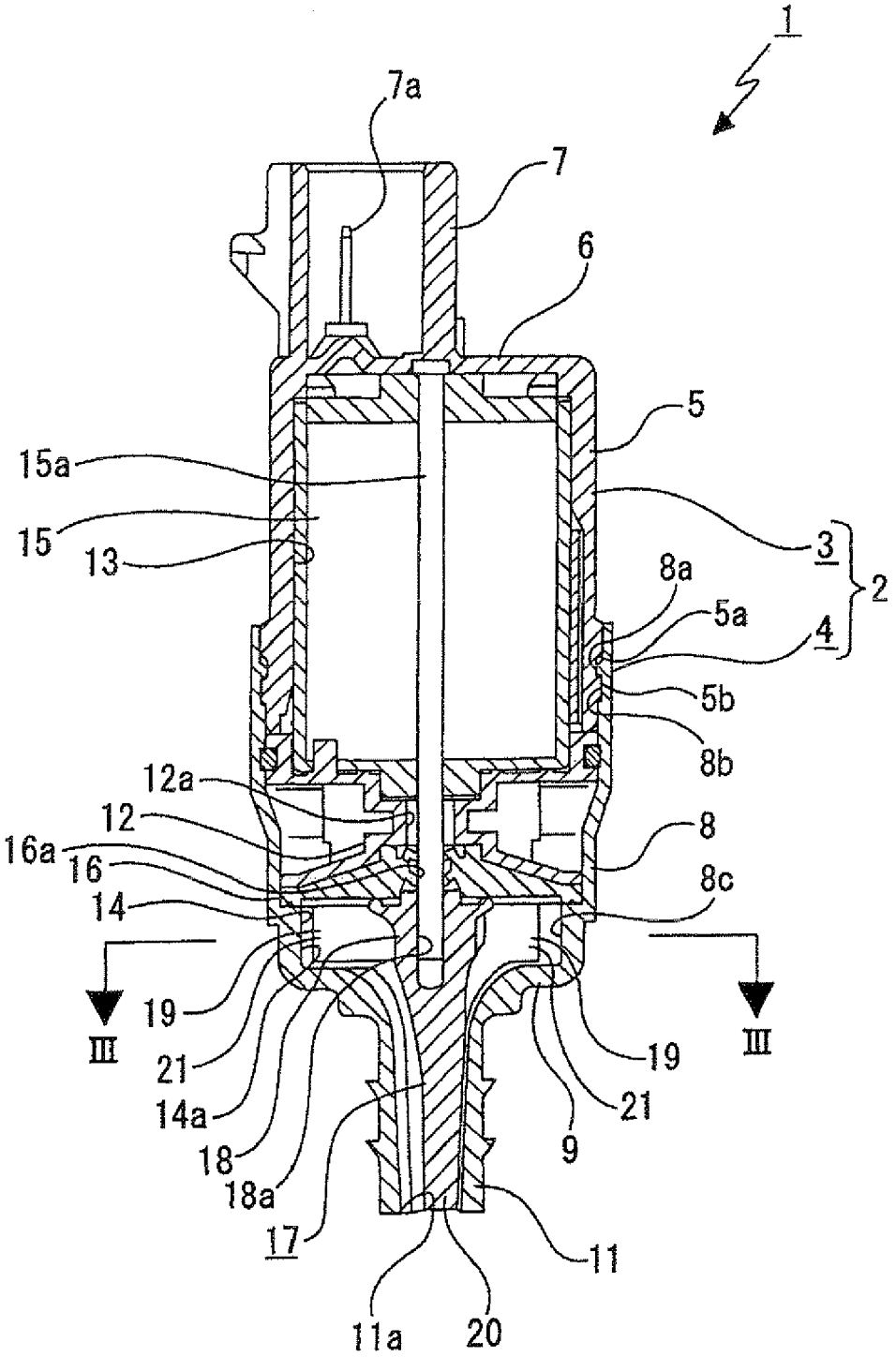

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FIG. 3

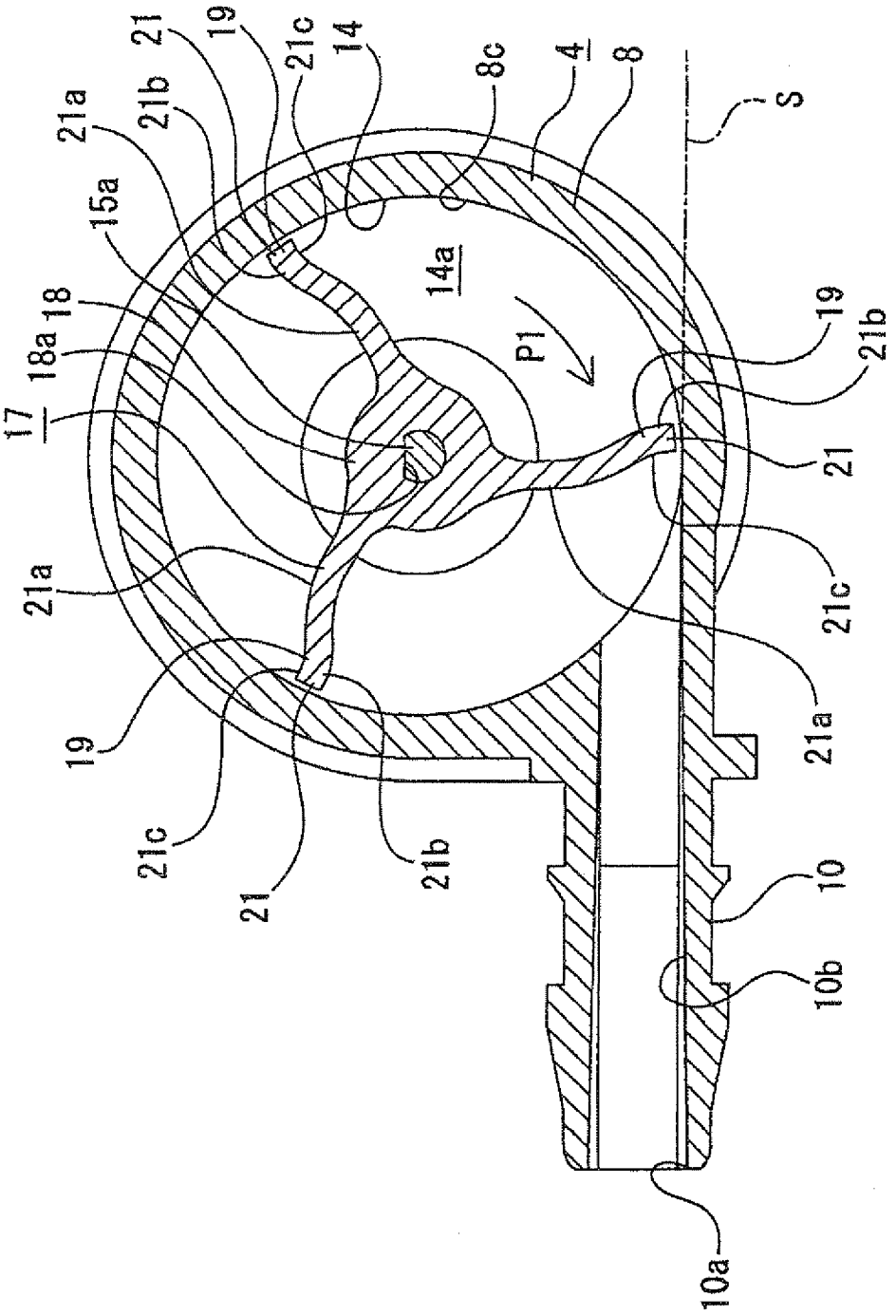
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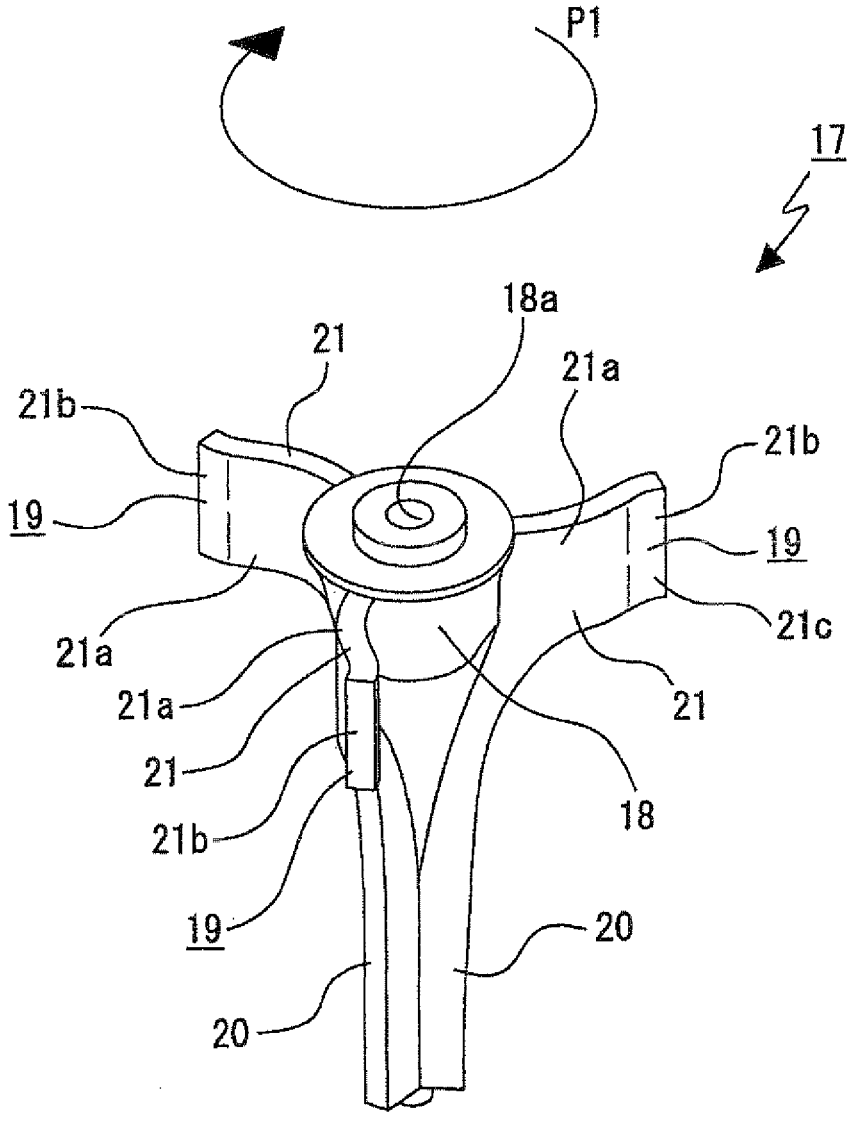
FIG. 4



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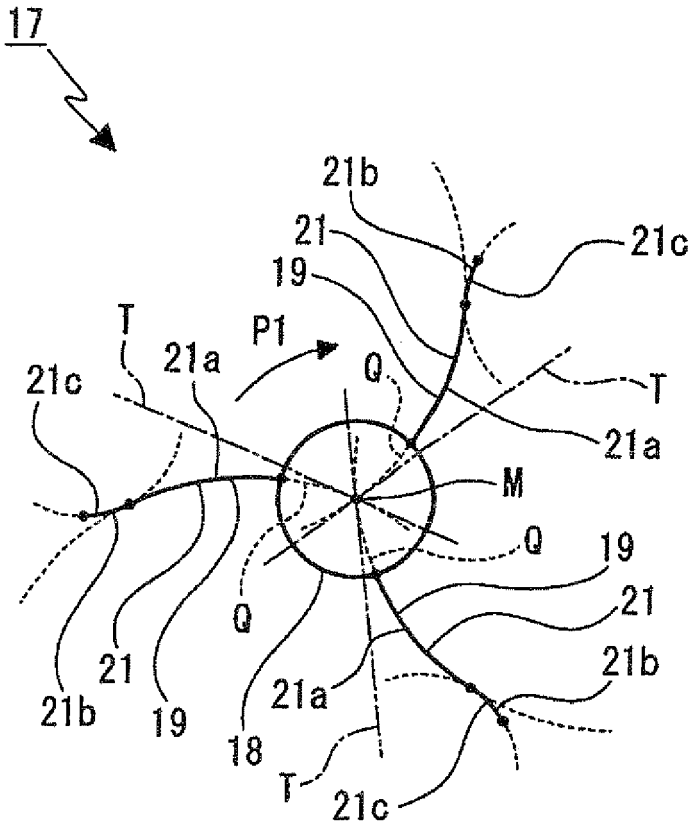
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EUROPEAN SEARCH REPORT

Application Number
EP 10 15 5912

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			TECHNICAL FIELDS SEARCHED (IPC) F04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 July 2010	Giorgini, Gabriele

CATEGORY OF CITED DOCUMENTS

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1 EPO FORM 1503 03.82 (P04C01)

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- JP 2006299898 A **[0007] [0008] [0009]**