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CERTIFICATION

I, Isamu Watanabe, Patent Attorney of WATANABE & HOTTA,
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Shinjuku-ku, Tokyo, Japan, hereby certify that I am a translator
of the accompanying International Patent Application No.
PCT/JP97/00002 filed on January 6, 1997, and certify that the
following is a true and correct translation to the best of my
knowledge and belief.


Isamu Watanabe

Dated this 4th day of August, 1998

DESCRIPTION**PUMP ASSEMBLY****Technical Field**

5 The present invention relates to a pump assembly, and more particularly to a pump assembly which incorporates a frequency converter.

Background Art

10 There has been known a pump assembly in which a frequency converter including an inverter as a typical example is mounted on an electric motor pump and heat generated from the frequency converter is removed by a liquid handled by the pump assembly. A frequency converter which is mounted on a cylindrical outer
15 surface of a pump casing in a full-circumferential flow pump is disclosed in Japanese patent application No. 5-350994 (Japanese laid-open patent publication No. 7-189996). In the pump assembly disclosed in Japanese laid-open patent publication No. 7-189996, by mounting an inverter on an outer surface of
20 an outer cylinder of a full-circumferential flow pump, a heat sink for the inverter is unnecessary to allow the inverter to be small-sized. Further, a motor is small-sized by increasing frequency of electric power supplied thereto, and a pump is also small-sized by increasing a rotational speed thereof.

25 However, the pump assembly disclosed in Japanese laid-open patent publication No. 7-189996 has the following disadvantages:

1) As shown in FIG. 1 of Japanese laid-open patent publication No. 7-189996, in case of mounting the inverter on

the outer surface of the outer cylinder, a lower case (represented by reference numeral 48 in FIG. 2) for housing the inverter therein must have a lower surface which corresponds to a curvature of the outer cylinder. This is disadvantageous when the inverter having the identical electrical characteristics is attached to the outer cylinder having a different curvature. For example, a two-stage pump having two impellers is disclosed in FIG. 1 of Japanese laid-open patent publication No. 7-189996, and depending on the circumstances, it is necessary to use a single-stage pump having a single large-sized impeller to make an axial dimension of the pump shorter. In this case, the diameter of the single-stage impeller is approximately 1.4 times that of the two-stage impeller disclosed in Japanese laid-open patent publication No. 7-189996. Therefore, in order to house the large-sized impeller in the outer cylinder, it is necessary to make the diameter of the outer cylinder larger. Thus, different kinds of lower cases each having a specific shape are required to house an inverter therein.

2) In the pump assembly shown in FIG. 1 of Japanese laid-open patent publication No. 7-189996, since the lower case is fixed to the outer cylinder by welding, the installation of associated parts such as a board of the inverter cannot be carried out until a motor stator assembly is completed. Therefore, the verification test of the inverter cannot be performed until the motor is completed, and if the inverter is judged to be defective by the test, reassembly of the motor is required to thus take a lot of time and labor.

3) In the pump assembly shown in FIG. 1 of Japanese laid-open patent publication No. 7-189996, if the pump is excessively small-sized by increasing a rotational speed thereof, an installation space for the inverter cannot be ensured. It is known that the motor and the pump can be small-sized by increasing their rotational speeds. The size of the inverter has no relation with the rotational speed of the motor, and is determined by its capacity and cooling condition.

It is therefore an object of the present invention to provide a pump assembly which can easily deal with a change in curvature of an outer cylinder constituting an outer surface of a motor pump, can assemble a frequency converter assembly independently, and can readily mount the frequency converter assembly on the small-sized motor pump.

Disclosure of Invention

In order to achieve the above object, according to the present invention, there is provided a pump assembly comprising a motor pump having a space defined around a stator of a motor for allowing a liquid handled by the motor pump to flow, a bracket attached to an outer surface of the motor pump, and a frequency converter assembly mounted on the bracket.

According to the present invention, the bracket is provided between the frequency converter assembly and the outer cylinder of the pump casing. The bracket serves as a dimension adjustment member, and is dimensioned such that it is smaller than the base of the frequency converter assembly. The bracket is a small component, and hence the preparation of many kinds

of brackets does not lead to a lowering of productivity.

According to the present invention, the frequency converter assembly comprises a base mounted on the bracket, a cover attached to the base, and a frequency converter housed
5 in the base and the cover. Thus, the frequency converter assembly can be independently assembled. The cover and the base are unnecessary to be disassembled from each other normally, except for maintenance of the frequency converter. That is, when the frequency converter is mounted on the pump or removed from
10 the pump, the highly integrated circuit of the frequency converter is not exposed to the outside. This structure is effective because the highly integrated circuit or the electrical board is weak in dust or dirt.

According to one aspect of the present invention, the
15 bracket has the through hole to connect the canned motor and the frequency converter electrically. Thus, attachment of the frequency converter assembly to the motor pump can be made with ease.

According to one aspect of the present invention, the
20 bracket, the base and the cover are composed of thermally good conductor, i.e., aluminum alloy. Since the frequency converter of this kind is mainly cooled by a liquid handled by the pump, aluminum alloy is preferable. The above members are made of metal to thus shield radiation noise from the frequency converter.
25 Especially, the bracket is made of metal to thus shield harmonic noise generated in the secondary side of the frequency converter.

Further, according to one aspect of the present invention, the bracket has the through hole for allowing cooling water to

pass therethrough. The frequency converter is normally cooled by a liquid handled by the pump. If the liquid handled by the pump has high temperature, the frequency converter cannot be cooled by the pumped liquid. In such a case, cooling liquid can
5 be supplied from the outside to the though hole to thus cool the frequency converter sufficiently.

According to one aspect of the present invention, heat transfer medium is interposed between the outer cylinder and the bracket, between the bracket and the base, and between the
10 base and the cover. If a clearance is formed between two members, air is in the clearance to prevent heat transfer between two members, resulting in inferior cooling. Therefore, heat transfer medium such as liquid silicon is charged into the clearance to improve heat transfer between two members.

15 According to one aspect of the present invention, sealing members are provided between the motor pump and the bracket, between the bracket and the base, and between the base and the cover, respectively. Thus, moisture is prevented from entering the case housing the frequency converter, and the frequency
20 converter is not deteriorated due to dew formed by moisture when cooled by the liquid handled by the pump.

According to the present invention, there is provided a pump assembly comprising an outer motor frame barrel provided around a stator of a motor, an outer cylinder defining an annular
25 space between the outer motor frame barrel and the outer cylinder, a pump section for allowing a liquid handled by the pump assembly to flow in the annular space, and fixing means provided at an axial end of the outer cylinder for fixing another member,

wherein a frequency converter assembly is fixed to an outer circumferential portion of the outer cylinder, and a part of the frequency converter assembly is axially extended beyond the fixing means provided at the axial end of the outer cylinder.

5 According to the present invention, the fixing means comprising the flanges for connecting the suction-side casing, the discharge-side casing or the like to the outer cylinder are provided. Thus, in the conventional structure, if the pump becomes excessively small, an installation space cannot be
10 ensured. However, in the present invention, attachment of the frequency converter is not limited by the fixing means comprising the flanges, and the frequency converter assembly is not interfered with the fixing means comprising the flanges by using "high-floor structure".

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Brief Description of Drawings

Fig. 1 is a cross-sectional view of a pump assembly according to the present invention;

FIG. 2 is a cross-sectional view taken along line II-II of FIG. 1; and
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FIG. 3 is a plan view of a bracket in the pump assembly according to the present invention.

Best Mode for Carrying Out the Invention

25 A pump assembly according to an embodiment of the present invention will be described below with reference to FIGS. 1 and 2.

A full-circumferential-flow pump of this embodiment

comprises a pump casing 1, a canned motor 6 housed in the pump casing 1, and an impeller 8 fixedly mounted on a main shaft 7 of the canned motor 6. The pump casing 1 comprises an outer cylinder 2, a suction-side casing 3 connected to an axial end of the outer cylinder 2 by flanges 61, 62, and a discharge-side casing 4 connected to an opposite axial end of the outer cylinder 2 by flanges 61, 62. The flanges 61 and 62 constitute fixing means for fixing another member such as the suction-side casing 3 or the discharge-side casing 4 to the outer cylinder 2. Each of the outer cylinder 2, the suction-side casing 3, and the discharge-side casing 4 is made of a pressed sheet of stainless steel or the like.

A bracket 45 is attached to the outer surface of the outer cylinder 2. A frequency converter assembly 50 is mounted on the bracket 45. The frequency converter assembly 50 comprises a base 46 attached to the bracket 45, a cover 47 attached to the base 46, and a frequency converter 48 housed in the base 46 and the cover 47.

The bracket 45 has a through hole 45a for allowing leads for connecting the canned motor 6 and the frequency converter 48 to pass therethrough. The bracket 45, the base 46 and the cover 47 are composed of thermally good conductor such as aluminum alloy. The bracket 45 has a through hole 45b for allowing cooling water for cooling the frequency converter 48 to pass therethrough.

The canned motor 6 comprises a stator 13, an outer motor frame barrel 14 fixedly fitted over the stator 13, a pair of motor frame side plates 15, 16 welded to respective opposite open ends of the outer motor frame barrel 14, and a can 17 fitted in the stator 13 and welded to the motor frame side plates 15, 16. The

canned motor 6 also has a rotor 18 rotatably disposed in the stator 13 and shrink-fitted over the main shaft 7. An annular fluid passage 40 is formed between the outer motor frame barrel 14 and the outer cylinder 2.

5 Further, a guide device 11 for guiding fluid from a radially outer direction toward a radially inner direction is held by the motor frame side plate 16. An inner casing 12 for housing an impeller 8 therein is fixed to the guide device 11. A sealing member 13 is provided on the outer periphery of the
10 guide device 11.

 A liner ring 51 is mounted on a radially inner end of the guide device 11 and is in slide contact with the forward end (suction mouth) of the impeller 8. The inner casing 12 has a dome-like shape so that it covers the end of the main shaft 7
15 of the canned motor 6. The inner casing 12 has a guide device 12a comprising a guide vane or a volute for guiding fluid discharged from the impeller 8. The inner casing 12 has a vent hole 12b at the forward end thereof.

 A cable housing 20 is welded to the outer motor frame barrel
20 14. Leads from coils disposed in the outer motor frame barrel 14 are extended through the cable housing 20, the through hole 45a of the bracket 45 and a lead hole 46a of the base 46, and connected to the frequency converter 48 in the base 46 and the cover 47. Further, a cable 63 is introduced into the base 46 and connected
25 to leads of the frequency converter 48 in the base 46 and the cover 47. The outer cylinder 2 has a hole 2a into which the cable housing 20 is inserted.

 Next, a bearing assembly at the impeller side will be

described. A radial bearing 22 and a stationary thrust bearing 23 are mounted on a bearing bracket 21. The radial bearing 22 has an end which serves as a stationary thrust sliding member. A rotary thrust bearing 24 and a rotary thrust bearing 25 each serving as a rotary thrust sliding member are disposed one on each side of the radial bearing 22 and the stationary thrust bearing 23. The rotary thrust bearing 24 is secured to a thrust disk 26 which is fixed to the main shaft 7 through a key. The rotary shaft bearing 25 is secured to a thrust disk 27 which is fixed to the main shaft 7 through a key.

The bearing bracket 21 is inserted in a socket defined in the motor frame side plate 16 through a resilient O-ring 29. The bearing bracket 21 is also held against the motor frame side plate 16 through a resilient gasket 30. The radial bearing 22 slidably supports a sleeve 31 which is fitted over the main shaft 7.

Next, a bearing assembly at the opposite side of the impeller will be described. A radial bearing 33 is mounted on a bearing bracket 32, and slidably supports a sleeve 34 which is fitted over the main shaft 7. The sleeve 34 is axially held against a washer 35 which is fixed to the main shaft 7 by a double nut 36 threaded over an externally threaded surface on an end of the main shaft 7. The bearing bracket 32 is inserted in a socket defined in the motor frame side plate 15 through a resilient O-ring 37. The bearing bracket 32 is also held against the motor frame side plate 15. Stays 43 are welded to the outer motor frame barrel 14, and the stays 43 and the outer cylinder 2 are welded together. The rotational speed of the canned motor is set to 4,000 rpm or more by the frequency converter 48.

Operation of the full-circumferential-flow pump shown in FIG. 1 will be described below.

A fluid drawn into the suction-side casing 3 from the suction nozzle 3a flows into the annular fluid passage 40 defined
5 between the outer cylinder 2 and the outer motor frame barrel 14 through the suction-side casing 3. Then, the fluid is introduced into the impeller 8 through the annular fluid passage 40 and the guide device 11. The fluid discharged from impeller 8 is discharged through the guide device 12a from the discharge
10 nozzle 4a which is connected to the discharge-side casing 4.

According to this embodiment, the bracket 45 is provided between the frequency converter assembly 50 and the outer cylinder 2 of the pump casing 1. The bracket 45 serves as a dimension adjustment member, and is dimensioned such that it
15 is smaller than the base 46 of the frequency converter assembly 50. The bracket 45 is a small component, and hence the preparation of many kinds of brackets does not lead to a lowering of productivity.

As shown in FIG. 1, two fixing members 53 having respective
20 bolts fixed thereto are fixed at a certain interval to the outer cylinder 2 by welding. On the other hand, as shown in FIG. 3, the bracket 45 has notches 45c at its both ends. The bracket 45 is fixed to the outer cylinder 2 in such a manner that the notches 45c of the bracket 45 are fitted with the fixing members
25 53, respectively, and then nuts 54 are fastened to the bolts 52, respectively.

Next, the method for fixing the frequency converter assembly 50 to the motor pump will be described.

First, the frequency converter 50 is independently assembled by housing the frequency converter 48 in the base 46 and the cover 47. After the frequency converter 50 is assembled, the frequency converter 50 and the bracket 45 are fixed to each other. This is preformed by fastening the bolts 55 to the base 46 through the bracket 45. This work can be made from the outside of the frequency converter assembly 50. After the bracket 45 and the frequency converter assembly 50 are fixed to each other, the notches 45c of the bracket 45 are fitted with the fixing members 53, respectively, and the nuts 54 are fastened to the bolts, respectively, whereby the bracket 45 is fixed to the outer cylinder 2 of the motor pump.

In this manner, the frequency converter assembly 50 comprises the base 46 attached to the bracket 45, the cover 47 attached to the base 46, and the frequency converter 48 housed in the base 46 and the cover 47. Therefore, the frequency converter assembly 50 can be independently assembled. The fixing of the bracket 45 and the frequency converter assembly 50 to each other can be carried out from the outside of the frequency converter assembly 50. Further, after the bracket 45 and the frequency converter assembly 50 are fixed to each other, the bracket 45 can be fixed to the outer cylinder 2. The cover 47 and the base 46 are unnecessary to be disassembled from each other normally, except for maintenance of the frequency converter 48. That is, when the frequency converter is mounted on the pump or removed from the pump, the highly integrated circuit of the frequency converter is not exposed to the outside. This structure is effective because the highly integrated

circuit or the electrical board is weak in dust or dirt.

According to this embodiment, the bracket 45 has the through hole 45a to connect the canned motor 6 and the frequency converter 48 electrically. Thus, attachment of the frequency converter assembly 50 to the motor pump can be made with ease.

According to this embodiment, the bracket 45, the base 46 and the cover 47 are composed of thermally good conductor, i.e., aluminum alloy. Since the frequency converter of this kind is mainly cooled by a liquid handled by the pump, aluminum alloy is preferable. The above members are made of metal to thus shield radiation noise from the frequency converter. Especially, the bracket is made of metal to thus shield harmonic noise generated in the secondary side of the frequency converter.

Further, according to this embodiment, the bracket 45 has the through hole 45b for allowing cooling water to pass therethrough. The frequency converter is normally cooled by a liquid handled by the pump. If the liquid handled by the pump has high temperature, the frequency converter cannot be cooled by the pumped liquid. In such a case, cooling liquid can be supplied from the outside to the through hole 45b of the bracket 45 to cool the frequency converter sufficiently.

According to this embodiment, heat transfer medium is interposed between the outer cylinder 2 and the bracket 45, between the bracket 45 and the base 46, and between the base 46 and the cover 47. If a clearance is formed between two members, air is in the clearance to prevent heat transfer between two members, resulting in inferior cooling. Therefore, heat transfer medium such as liquid silicon is charged into the

clearance to improve heat transfer between two members.

According to this embodiment, sealing members 56, 57 and 58 are provided between the outer cylinder 2 and the bracket 45, between the bracket 45 and the base 46, and between the base 46 and the cover 47, respectively. Thus, moisture is prevented from entering the case housing the frequency converter 48, and the frequency converter is not deteriorated due to dew formed by moisture when cooled by the liquid handled by the pump.

Further, according to this embodiment, in the pump assembly comprising the outer motor frame barrel 14 provided around the stator 13 of the canned motor 6, the outer cylinder 2 defining the annular fluid passage 40 between the outer motor frame barrel 14 and the outer cylinder 2, a pump section including the impeller 8 for allowing liquid to flow in the annular fluid passage 40, and fixing means comprising the flanges 61 and 62 for fixing another member such as the suction-side casing 3 or the discharge-side casing 4 to the outer cylinder 2, the frequency converter assembly 50 is mounted on the outer circumferential portion of the outer cylinder 2, and both ends of the frequency converter assembly are axially extended beyond the fixing means 61, 62 provided at both ends of the outer cylinder 2.

As described above, according to this embodiment, the fixing means comprising the flanges 61, 62 for connecting the suction-side casing 3, the discharge-side casing 4 or the like to the outer cylinder 2 are provided. Thus, in the conventional structure, if the pump becomes excessively small, an installation space cannot be ensured. However, in the present

invention, attachment of the frequency converter is not limited by the fixing means comprising the flanges 61, 62, and the frequency converter assembly 50 is not interfered with the fixing means comprising the flanges 61, 62 by using "high-floor
5 structure". Thus, a part of the frequency converter assembly 50 can be axially extended beyond the fixing means.

As described above, according to the present invention, the inverter, the motor and the pump can be individually small-sized, and hence the entire structure of the pump assembly
10 can be extremely small-sized.

Further, according to the present invention, a change in a curvature of the outer cylinder which constitutes an outer surface of the motor pump can be easily dealt with, and the frequency converter assembly can be independently assembled and
15 can be readily attached to the small-sized motor pump.

Industrial Applicability

The present invention relates to a pump assembly which pumps liquid from a low place to a high place by imparting pressure
20 energy and velocity energy to the liquid by rotation of an impeller and converting velocity energy to pressure energy efficiently while the liquid flows in a pump casing. The pump assembly can pump various kinds of liquids including water and can be utilized in buildings, or the chemical industry and the
25 like.

**CLAIMS**

1. A pump assembly comprising:
a motor pump having a space defined around a stator of
5 a motor for allowing a liquid handled by said motor pump to flow;
a bracket attached to an outer surface of said motor pump;
and
a frequency converter assembly mounted on said bracket.
- 10 2. A pump assembly according to claim 1, wherein said
frequency converter assembly comprises a base mounted on said
bracket, a cover attached to said base, and a frequency converter
housed in said base and said cover.
- 15 3. A pump assembly according to claim 1 or 2, wherein
said bracket has a hole for connecting said motor and said
frequency converter electrically.
4. A pump assembly according to any one of claims 1 to
20 3, wherein said bracket comprises a thermally good conductor.
5. A pump assembly according to any one of claims 2 to
4, wherein said base comprises a thermally good conductor.
- 25 6. A pump assembly according to any one of claims 2 to
4, wherein said cover comprises a thermally good conductor.
7. A pump assembly according to any one of claims 4 to

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6, wherein said thermally good conductor comprises aluminum alloy.

8. A pump assembly according to any one of claims 1 to 5 7, wherein said motor pump comprises an outer motor frame barrel provided around said stator, an outer cylinder defining an annular space between said outer motor frame barrel and said outer cylinder, a pump section for allowing the liquid handled by said motor pump to flow in said annular space, and power 10 connecting means provided on an outer surface of said outer cylinder for driving said motor.

9. A pump assembly according to any one of claims 1 to 8, wherein said bracket has a hole for allowing cooling liquid 15 for cooling said frequency converter to pass therethrough.

10. A pump assembly according to any one of claims 2 to 9, further comprising heat transfer medium which is interposed between said motor pump and said bracket, or between said bracket 20 and said base, or between said base and said cover.

11. A pump assembly according to any one of claims 2 to 10, further comprising sealing members provided between said motor pump and said bracket, between said bracket and said base, 25 and between said base and said cover.

12. A pump assembly according to any one of claims 1 to 11, wherein fixing of said bracket and said frequency converter

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assembly to each other is carried out from the outside of said frequency converter assembly.

13. A pump assembly according to any one of claims 1 to 5 12, wherein said bracket and said motor pump are capable of fixing to each other after said bracket and said frequency converter assembly are fixed to each other.

14. A pump assembly comprising:
10 an outer motor frame barrel provided around a stator of a motor;

an outer cylinder defining an annular space between said outer motor frame barrel and said outer cylinder;

a pump section for allowing a liquid handled by said pump
15 assembly to flow in said annular space; and

fixing means provided at an axial end of said outer cylinder for fixing another member;

wherein a frequency converter assembly is fixed to an outer circumferential portion of said outer cylinder, and a part of
20 said frequency converter assembly is axially extended beyond said fixing means provided at said axial end of said outer cylinder.

15. A pump assembly according to claim 14, wherein a
25 rotational speed of said pump assembly is set to 4,000 rpm or more.

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