Decision on Opposition

Opposition No. 2019-700116

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| Patentee | Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. |
| Patent Attorney | Seishin IP Patent Firm, P.C. |
| Opponent | KAWAI Co., Ltd. |
| Patent Attorney | HIROE and ASSOCIATES |

The case of opposition against the patented invention of Japanese Patent No. 6386162, entitled "Impeller for Rotary Machine, Compressor, Supercharger, and Method for Producing Impeller of Rotary Machine", has resulted in the following decision.

Conclusion

The patents concerning Claims 1 and 9 of Japanese Patent No. 6386162 are to be revoked.

Reason

No. 1 History of the procedures

The application regarding the patents concerning Claims 1 to 12 of Japanese Patent No. 6386162 (hereinafter, referred to as "the Patents") is an application originally filed on March 25, 2015 (Heisei 27) as an International Patent Application, the establishment of the patent right was registered on August 17, 2018, and a gazette containing the patents was issued on September 5 of the same year. The history of the opposition to the granted patent of the case regarding the Patents is as follows.

February 13, 2019 : Opposition to the granted patent by the patent opponent regarding the patents concerning Claim 1 and Claim 9 among the Patents

As of May 31, 2019 : A written notice of reasons for revocation

August 1, 2019 : Submission of a written opinion by the patentee

As of September 13, 2019 : A written notice of reasons for revocation (advance notice of decision)

November 15, 2019 : Submission of a written correction request and a written

opinion by the patentee
As of December 26, 2019 : A notice of reasons for refusal of correction
February 10, 2020 : Submission of a written withdrawal of the request for correction by the patentee

No. 2 The patent invention

The inventions according to Claims 1 and 9 of Japanese Patent No. 6386162 (hereinafter, referred to as "Patent Invention 1" and "Patent Invention 9", respectively) are ones that are specified by the matters described in Claims 1 and 9 of the Scope of Claims as follows.

"[Claim 1]

An impeller for a rotary machine, comprising:

a base material of the impeller comprising Al or an Al alloy; and

an electroless plating layer disposed so as to cover the base material, the electroless plating layer forming a surface layer of the impeller,

wherein the electroless plating layer comprises an Ni-P based alloy having an amorphous structure, the Ni-P based alloy having a P content rate of not less than 5 wt% and not more than 11 wt% in the electroless plating layer."

"[Claim 9]

A method of producing an impeller for a rotary machine, comprising

a step of forming an electroless plating layer as a surface layer of the impeller comprising Al or an Al alloy, so as to cover a base material of the impeller,

wherein the electroless plating layer comprises an Ni-P based alloy having an amorphous structure, the Ni-P based alloy having a P content rate of not less than 5 wt% and not more than 11 wt% in the electroless plating layer."

No. 3 Outline of reasons for revocation

An outline of the reasons for revocation notified to the patentee by the body in the notice of reasons for revocation (advance notice of decision) as of Sep. 13, 2019 with respect to the patents according to Claims 1 and 9 is as follows.

The inventions according to Claims 1 and 9 are ones that could have been invented by a person skilled in the art easily based on an invention described in Evidence A No. 1 and a matter described in Evidence A No. 2, and, therefore, the patents concerning Claims 1 and 9 violate the provisions of Article 29(2) of the Patent Act. Accordingly, the patents concerning Claims 1 and 9 should be invalidated.

No. 4 Evidence A No. 1 and Evidence A No. 2

1. Evidence A No. 1

(1) Descriptions in Evidence A No. 1

In Evidence A No. 1 (Japanese Unexamined Patent Application Publication No. 2014-163345) distributed in advance of the Patent application, there are the following statements relating to "Exhaust gas recirculation system of marine diesel engine" (underlines have been given by the body for the purpose of facilitating understanding, and the same applies hereafter).

A. "[0001]

The present invention relates to an exhaust gas recirculation system for a marine diesel engine which is capable of preventing erosion and the like generated in a compressor of a supercharger."

B. "[0004]

However, when the exhaust gas is passed through a scrubber, droplets come to be contained in the exhaust gas after passing through the scrubber. On the other hand, in a diesel engine, a supercharger is often used for improving performance. The present inventors have paid attention to a phenomenon that, when a compressor constituting a supercharger is provided in an air supply passage, and a mixed flow of recirculated exhaust gas and supply air passes through the compressor, an erosion in which the surface of the impeller of the compressor is mechanically deformed or shaved off is easily caused by droplets contained in the exhaust gas. Also, the present inventors have found a phenomenon that, in the heavy oil used as a fuel of a marine diesel engine, an S (sulfur) component is contained, and droplets containing the S component tend to cause chemical corrosion of a blade surface of a compressor."

C. "[0011]

In view of such problems of the prior art, the object of the present invention is to provide an exhaust gas recirculation system for a marine diesel engine having a scrubber in a recirculation passage, which is capable of preventing damage such as erosion and corrosion occurring in the compressor of a supercharger by a simple and low-cost means."

D. "[0026]

FIG. 2 shows an impeller 38 constituting a compressor 20. The impeller 38 is made of Al or an Al alloy and has a plurality of blades 40 radially disposed in the radial direction. The impeller 38 is coupled to a rotating shaft 22 and is connected to an exhaust turbine 18 via the rotating shaft 22. The compressor 20 rotates with the exhaust turbine 18 around the rotating shaft 22 due to the dynamic pressure of the

exhaust gas.

[0027]

In the impeller 38, a plating film made of an Ni-P alloy plated by an electroless plating method is formed on all surfaces including the blades 40. As will be described later, the thickness of the plating film is preferably from 15 μm to 60 μm. An air supply a containing exhaust gas recirculated from an exhaust circulation passage 24 enters from an axial direction of the rotating shaft 22, is pressurized by rotation of the impeller 38, and is discharged toward an outer side in a radial direction of the impeller 38. A front edge 40a of each of the blades 40 is arranged at a position facing the inlet direction of the air supply a."

E. From the statements of the above-mentioned D., it can be understood that the base material of the impeller 38 is composed of Al or an Al alloy.

F. From the statements of the above-mentioned D., it can be understood that the plating film is provided so as to cover the base material to form a surface layer of the impeller 38, and the plating film is formed using an electroless plating method.

G. From the statements of the above-mentioned D., it can be understood that the manufacturing method of the impeller 38 of the compressor 20 includes a step of forming a plating film using an electroless plating method as a surface layer of the impeller 38 so as to cover the base material of the impeller 38 composed of Al or an Al alloy.

(2) The inventions described in Evidence A No. 1

When the above-mentioned (1) and the drawings are integrated, the following inventions (hereinafter, referred to as "Invention A-1 No. 1" and "Invention A-1 No. 2", and these are also generally referred to as "Invention A-1") are described in Evidence A No. 1.

A. Invention A-1 No. 1

"An impeller 38 of a compressor 20, comprising:

a base material of the impeller 38 composed of Al or an Al alloy; and

a plating film provided so as to cover the base material to form a surface layer of the impeller 38 using an electroless plating method, wherein

the plating film is made of an Ni-P based alloy."

B. Invention A-1 No. 2

"A manufacturing method of an impeller 38 of a compressor 20, the method comprising

a step of forming a plating film using an electroless plating method as a surface layer of the impeller 38 so as to cover a base material of the impeller 38which is

composed of Al or an Al alloy, and

the plating film is made of an Ni-P based alloy."

2. Evidence A No. 2

(1) Descriptions in Evidence A No. 2

In Evidence A No. 2 (Japanese Unexamined Patent Application Publication No. 2008-127598) distributed in advance of the patent application of the case, there are the following statements relating to "METHOD FOR FORMING CORROSION RESISTANT PLATING LAYER, AND ROTARY MACHINE".

A. "[0001]

The present invention relates to a method for forming a corrosion-resistant plating layer by electroless nickel-based plating and to a rotary machine processed by the method for forming a corrosion-resistant plating layer."

B. "[0002]

Compressors (rotary machines) used in power-generating plants and chemical plants compress gases containing corrosive gases such as CO2, H2S, and H2O. When carbon steel (cast iron, cast steel, or forged steel) is used as the base material for a compressor, since the anti-corrosion properties of the carbon steel are not sufficient, electroless nickel-based plating, such as Ni-P plating, is generally performed on a diaphragm and an impeller, which are exposed to corrosive gases.

However, as shown in FIG. 11, defects, such as cavities, are tend to be formed, particularly, in carbon steel during casting, and pores 100a having openings are formed in a surface of a base material 100. When the pores 100a as described above are formed, even if electroless plating is performed on the base material 100, penetrating pinholes 101a are formed in an electroless plating layer 101 to penetrate the surface thereof.

When the penetrating pinholes 101a as described above are formed, as shown in FIG. 12, a corrosive liquid infiltrates the base material 100. As a result, corrosion products 100b are formed on the base material 100. In addition, as the corrosion products 100b gradually grow, the electroless plating layer 101 is eventually peeled away.

The penetrating pinholes as described above may originate at a complex-shaped portion, such as a diaphragm or an impeller."

C. "[0020]

Hereinafter, embodiments of the present invention will be described with reference to the drawings.

In this embodiment, a corrosion prevention treatment is performed on a diaphragm and an impeller of a compressor which is exposed to a corrosive gas, such as CO2, H2S, and H2O, by electroless Ni-P plating. Carbon steel (cast iron, cast steel, or forged steel) is used as a base material to be processed by the anti-corrosion treatment.

FIG. 1 shows steps of performing the anti-corrosion treatment on the base material by electroless Ni-P plating.

As shown in the above figure, after cleaning, degreasing, and water washing are performed for the base material, pickling is performed, followed by water washing. Subsequently, after pickling is performed with dilute sulfuric acid, water washing is performed, and the electroless Ni-P plating is then performed. Accordingly, a first plating step is completed. With this process, as shown in FIG. 2, a first plating layer 3 is formed on the base material 1. In this figure, a penetrating pinhole 3a formed in the first plating layer 3 is shown."

D. "[0026]

Next, Examples will be described.

[Investigation of P Concentration of Electroless Ni-P Plating Layer]

First, in order to optimize the P concentration of an electroless Ni-P plating layer, the corrosion rate was evaluated by measuring polarization properties performed while the P concentration was varied.

(1) Test Specimen

JIS SPCC (cold-rolled carbon steel) was used as a base material, and an electroless Ni-P plating layer was formed on a surface of the base material by varying the P concentration from 2.5 to 12.5 wt% under the conditions shown in Table 1.

TABLE 1 Electroless Ni-P plating test Types of prepared solutions

[TABLE 1] (Omitted)

[0027]

(2) Test Method

After anode/cathode polarization curves were measured by an electrochemical corrosion test, a corrosion current density (Icorr) was obtained by the Tafel method (see FIG. 3) to evaluate the anti-corrosion properties.

In FIG. 4, an electrochemical corrosion test apparatus used in this test is shown. A sample 12 is immersed in a test solution 10 and is disposed to face a counter electrode 14 made of Pt.

The test solution 10 is temperature-controlled by a heater 18 of water-heating type disposed around the periphery. The temperature of the test solution 10 is measured by a thermometer 16. In the test solution 10, CO2 and H2S gases are

introduced as simulated corrosive gases. The test solution 10 is agitated by a stirrer 20.

The sample 12 and the counter electrode 14 are each connected to a potentio-galvanostat 21. A salt bridge 22 is connected to the sample 12. The other end of the salt bridge 22 is immersed in a bath 24 together with a reference electrode (Ag/AgCl electrode) 23 connected to the potentio-galvanostat 21.

The measurement conditions of this test are shown in Table 2.

TABLE 2 Measurement conditions for polarization properties

[TABLE 2] (Omitted)

[0028]

(3) Test Procedure

The test procedure is as shown below.

(a) A test solution in a volume of 350 ml is received in an electrolytic bath made of glass (jacket type having a volume of 400 ml).

(b) An Ag/AgCl electrode is set as a reference electrode, Pt is set as a counter electrode, and the sample 12 (measurement test specimen) is set as a test electrode.

(c) While agitation is performed at 0.3 m/s by bubbling CO2 and H2S gases, the temperature of the test solution is increased to 80°C.

(d) A spontaneous potential (Ecorr) of the measurement test specimen (sample 12) is measured for 30 minutes.

(e) Polarization is performed to 400 mV on the cathode side relative to the spontaneous potential at a sweeping rate of 20 mV/min.

(f) Polarization is performed to 1,000 mV on the anode side relative to the spontaneous potential at a sweeping rate of 20 mV/min.

(g) Polarization curves shown in FIG. 3 are obtained from the above (e) and (f).

[0029]

(4) Test Results

FIG. 5 shows an anti-corrosion evaluation result obtained by the above electrochemical corrosion test.

Under this corrosion environment, a composition region in which the P concentration in an electroless Ni-P plating layer is from 7 to 10 wt%, considered to have the most superior corrosion resistance.

The reasons why a P concentration in an electroless Ni-P plating layer from 7 to 10 wt% is considered to have superior corrosion resistance are as follows.

(i) Comparison with a plating material having a P concentration from 2 to 3 wt%

In the case of a Ni-P plating layer having a P concentration from 2 to 3 wt% (approximately 5 wt% or less), the plating film is crystalline. When the P

concentration is more than 7 wt%, the plating film is amorphous. It could considered that due to the presence of sources of corrosion at grain boundaries in a crystalline film, the corrosion resistance thereof was inferior to that of an amorphous film.

(ii) Comparison with a plating material having a high P concentration of 10 wt% or more

Initially, it was estimated that a higher P concentration gave superior corrosion resistance; however, according to this test, at a P concentration of 10 wt% or more, the corrosion resistance was unexpectedly degraded. As the reason for this, it could considered that many pits caused by corrosion are generated in a high P material. Thereby the corrosion resistance is degraded. Although a passivation film, such as phosphorus oxide, can be formed on a plating surface, it could considered that as the P concentration is increased, microcrystals are formed. Since a microcrystalline passivation film containing a high P concentration has many breaking points, many pits caused by corrosion are generated. As a result, the corrosion current in a Tafel method was increased.

[0030]

According to the results described above, a concentration from 7 to 10 wt% is preferable as the P concentration of an electroless Ni-P plating layer.

Hence, in the investigation of the lamination of plating layers explained below, Nimuden SX manufactured by C. Uyemura & Co., Ltd. is used, which can form a plating film having a P concentration from 9 to 10 wt%."

E. From the statement of the above-mentioned D., in particular paragraphs [0029] and [0030], it can be understood that, in an electroless Ni-P plating layer to be applied in order to improve corrosion resistance, the most superior corrosion resistance is obtained when a P content rate is 7 to 10 wt%, and the plating film thereof is amorphous.

(2) Matter described in Evidence A No. 2

As viewed from the statements of the above-mentioned (1) and the drawings, in Evidence A No. 2, there is described the following matter.

"In an electroless Ni-P plating layer to be applied in order to improve corrosion resistance of an impeller of a rotary machine, the most superior corrosion resistance is obtained when a P content rate is 7 to 10 wt%, and the plating film thereof is amorphous."

No. 5 Judgment

1. Patent Invention 1

Patent Invention 1 and Invention A-1 No. 1 will be compared.

When Patent Invention 1 and Invention A-1 No. 1 are compared in consideration of their functions, structures, or technical significance, "the compressor 20" in Invention A-1 No. 1 corresponds to "rotary machine" in Patent Invention 1, and, in a similar fashion, "the plating film ... using an electroless plating method" or "plating film" corresponds to "electroless plating layer", and "is made of a Ni-P based alloy" corresponds to "comprises a Ni-P based alloy".

Therefore, the two are identical in the point of

"An impeller for a rotary machine, comprising:

a base material of the impeller comprising Al or an Al alloy; and

an electroless plating layer disposed so as to cover the base material, the electroless plating layer forming a surface layer of the impeller,

wherein the electroless plating layer comprises a Ni-P based alloy.", and are different in the following point.

<Different Feature 1>

In Patent Invention 1, it is specified as "the electroless plating layer having an amorphous structure, the Ni-P based alloy having a P content rate of not less than 5 wt% and not more than 11 wt% in the electroless plating layer", whereas,

in Invention A-1 No. 1, it is unclear about whether or not the plating film has an amorphous structure, and about a P content rate in the plating film.

When Different Feature 1 is examined, in Evidence A No. 2, it is described that, in an electroless Ni-P plating layer to be applied in order to improve corrosion resistance of an impeller of a rotary machine, the most superior corrosion resistance is obtained when the P content rate is 7 to 10 wt%, and the plating film thereof is amorphous.

Here, the base material of the impeller 38 of Invention A-1 No. 1 is Al or an Al alloy, whereas the base material of an impeller described in Evidence A No. 2 is carbon steel. However, in paragraph [0004] of Evidence A No. 1, there are statements that "in the heavy oil used as a fuel of a marine diesel engine, an S (sulfur) component is contained, and droplets containing the S component tend to cause chemical corrosion (corrosion) of a blade surface of a compressor", and, in paragraph [0011], "it is an object of the present invention to prevent damage such as erosion and corrosion occurring in the compressor of a supercharger.", and, further, in paragraph [0020] of Evidence A No. 2, there is statement that "In this embodiment, a corrosion prevention treatment is performed on a diaphragm and an impeller of a compressor which is exposed to a

corrosive gas, such as CO2, H2S, or H2O, by electroless Ni-P plating.", and, therefore, although base materials of plating are different from each other, both are impellers of rotary machines to be used in corrosive environment containing S component, have a common problem to be solved as improvement of a corrosion resistance property (corrosion resistance), and, in conjunction with this, as a means for solving the problem to be solved, have a common configuration in a point of including an electroless Ni-P plating layer.

Then, in Invention A-1 No. 1, it could have been easily conceived of by a person skilled in the art to focus attention on a P content rate of a plating film while referring to the matter described in Evidence A No. 2 in order to carry out plating more superior in corrosion resistance; to make the plating film consists of an amorphous structure of a P content rate of not less than 5 wt% and not more than 11 wt% is nothing but optimization or a preference of a numerical value range that can be done arbitrarily by a person skilled in the art; and it is obvious from the common general technical knowledge or the statements and the like of paragraph [0029] of Evidence A No. 2 that a plating film of a P content rate of such numerical value range is of an amorphous structure.

The patentee alleges, in the written opinion submitted on Aug. 1, 2019, that "Therefore, in the case where carbon steel (cast iron, cast steel, or forged steel) that has a problem to be solved in the anti-corrosion property is used as a base material, it is not a matter that could have been easily conceived by a person skilled in the art, by applying the invention described in Evidence A No. 2 that discloses that corrosion resistance is the most superior in a composition of a P concentration from 7 to 10 wt% in electroless Ni-P plating to Evidence A No. 1 that discloses that Al or an Al alloy superior in corrosion resistance is used as a base material of a rotary machine (impeller), and could not be easily arrived the inventions according to Claims 1 and 9 of the present application. (page 4, lines 14 to 19)". However, as described above, in Evidence A No. 1, there is a statement regarding the problem to be solved of corrosion, and, therefore, such allegation cannot be adopted.

In addition, the patentee alleges, in the same written opinion, that "In fact, in the present invention, a P content rate in a plating film is determined based, not on the viewpoint of corrosion resistance, but on the viewpoint of coexistence of erosion resistance and fracture resistance (fatigue strength) that have a hard-to-coexist relationship with each other. (page 4, line 6 to 8)". However, although erosion resistance and fracture resistance are features that are requested as a matter of course in a member used for a rotary machine, and, in paragraph [0011] of Japanese Unexamined

Patent Application Publication No. 2001-200390, there are statements, relating to a plating film formed in a member for a compressor in which a base material is Al, an Al alloy, or carbon steel, that "a phosphorus content rate in a plating film of a nickel-phosphorus base alloy is usually about 1 to 20 wt%, is preferably about 3 to 17 wt%, and more preferably is around 5 to 15 wt%. When the phosphorus content is too low, the desired effect as erosion prevention of a member is not exercised sufficiently. In addition, when the content of phosphorus is too high, a plating film becomes brittle, and, thus, it is preferred to make the phosphorus content rate be 20 wt% or less.", and, therefore, it is obvious that there is relation between brittleness and fracture resistance (fatigue strength) of plating. Consequently, it is a matter that was known by a person skilled in the art at the time of application of the present application to make, by adjusting a P content rate in an Ni-P plating film (optimally about 5 to 15 wt%), erosion resistance and fracture resistance (fatigue strength) coexist.

Then, even from the viewpoint of coexistence of erosion resistance and fracture resistance (fatigue strength), it is nothing but a matter of a degree predictable by a person skilled in the art that, when a plating film is made to be one having an amorphous structure whose P content rate is not less than 5 wt% and not more than 11 wt% by applying the matter described in Evidence A No. 2 to Invention A-1 No. 1, an effect as coexistence of erosion resistance and fracture resistance (fatigue strength) can be expected.

Therefore, Patent Invention 1 is an invention that could have been invented by a person skilled in the art with ease by applying the matter described in Evidence A No. 2 to Invention A-1 No. 1.

Meanwhile, although the patentee has submitted a written opinion on Nov. 15, 2019, the allegations in the written opinion are ones based on the correction that was requested by the Written correction request submitted on the same day and subsequently withdrawn by the written withdrawal of request for correction submitted on Feb. 10, 2020, and thus cannot be adopted.

(2) Patent Invention 9

Patent Invention 9 and Invention A-1 No. 2 will be compared.

When Patent Invention 9 and Invention A-1 No. 2 are compared in consideration of their functions, structures, or technical significance, "the compressor 20" in Invention A-1 No. 2 corresponds to "rotary machine" in Patent Invention 9, and, in a similar fashion, "the plating film being plated using an electroless plating method" or "plating film" corresponds to "electroless plating layer", and "is made of a Ni-P based

alloy" corresponds to "comprises a Ni-P based alloy".

Accordingly, the two are identical in the point of

"A method of producing an impeller for a rotary machine, comprising

a step of forming an electroless plating layer as a surface layer of the impeller comprising Al or an Al alloy, so as to cover a base material of the impeller,

wherein the electroless plating layer comprises an Ni-P based alloy."

and are different in the following point.

<Different Feature 2>

In Patent Invention 9, it is specified as "the electroless plating layer having an amorphous structure, the Ni-P based alloy having a P content rate of not less than 5 wt% and not more than 11 wt% in the electroless plating layer", whereas,

in Invention A-1 No. 2, it is unclear about whether or not the plating film has an amorphous structure, and about a P content rate in the plating film.

When Different Feature 2 is examined, Different Feature 2 is the same as Different Feature 1.

Therefore, Patent Invention 9 is one that could have been invented by a person skilled in the art easily by applying the matter described in Evidence A No. 2 to Invention A-1 No. 2.

No. 6 Closing

As above, the inventions according to Claims 1 and 9 could have been invented by a person skilled in the art easily based on Invention A-1 and the matter described in Evidence A No. 2, and, therefore, the patents concerning Claims 1 and 9 are ones that were made in violation of the provisions of Article 29(2) of the Patent Act, fall under Article 113(2) of the same Act, and thus should be revoked.

Therefore, the decision shall be made as described in the conclusion.

February 25, 2020

Chief administrative judge: KUBO, Ryuichi

Administrative judge: SASAKI, Yoshie

Administrative judge: KUBOTA, Haruhiko