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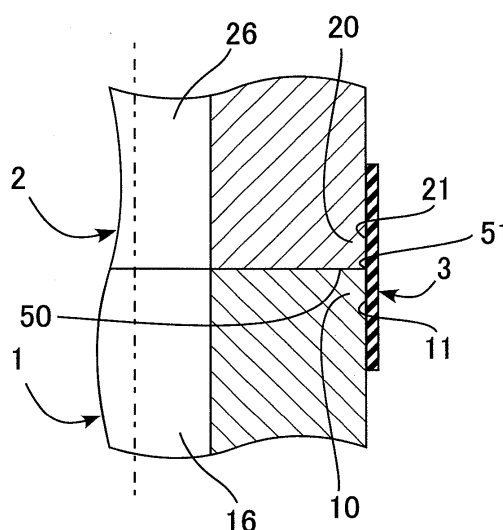
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(54) **STRUCTURE AND METHOD OF PREVENTING ELECTROLYTIC CORROSION OF THE STRUCTURE**

(57) A structural body of the present invention comprises a first member (1) having a first outside end portion (10) in which a first metal element is adapted to a major component; a second member (2) having a second outside end portion (20) in which a second metal element, being different from the first metal element, is adapted to a major component, and which is disposed to contact with the first outside end portion (10); and a coating member (3) comprising a coated film, at least whose outside superficial portion is composed of a fluoropolymer substance, and coating at least a part of both first outside end portion (10) and second outside end portion (20) so as to cover the contact portion (50) between them. Moreover, an electric-corrosion prevention method of the present invention, in the aforementioned structural body, inhibits the development of electric corrosion, which might possibly occur so as to stride over the contact portion (50) between the first outside end portion (10) and the second outside end portion (20), by hindering the electric conduction between the first outside end portion (10) and the second outside end portion (20) by means of the coating member (3).

In accordance with the structural body and electric-corrosion prevention method of the present invention, the electric corrosion between members of different metals can be prevented effectively.

Fig.2



DescriptionTECHNICAL FIELD

5 **[0001]** The present invention relates to a structural body, which can effectively prevent the electric corrosion occurring between different metals, and an electric-corrosion prevention method for the same.

BACKGROUND ART

10 **[0002]** Usually, even if being any apparatus, it is constituted of a combination of members, which are composed of metals. And, the types of used metals, too, are diverse, depending on the performance required for the respective parts. Therefore, such a construction that members of different metals are disposed in proximity to each other within an apparatus is not rare.

15 **[0003]** When disposing members of different metals in proximity to each other, it has been known that electric decay (electric corrosion) occurs between their both sides through water, and the like, as a medium. This electric corrosion takes place by means of the fact that various metals possess their intrinsic decay potentials (reference potentials) so that potential differences arise between them. That is, the electric corrosion develops by means of the fact that a local cell is formed while adapting both metals to electrodes and additionally adapting water or salt water, and the like, to an electrolyte. Therefore, not only the electric corrosion occurs between members of different metals by means of the fact
20 that water, and so forth, invades between the contact surfaces of both of them, but also the electric corrosion develops because, when water, and so forth, adheres onto the outer periphery of members of different metals being in proximity to each other, the water, and so on, plays a role of an electrolyte so that a local cell is formed so as to stride over the contact portion between both of them.

25 **[0004]** Namely, in order to effectively suppress or prevent the electric corrosion, it is needed that no local cell is formed not only by water (electrolyte), which invades between the contact surfaces of members of different metals, but also by means of water, which strides over the contact portions of the members of different metals to adhere them.

30 **[0005]** And, depending on the service environments and service conditions of apparatuses, it is inevitable that rainwater or seawater, dew condensate, and the like, adhere onto members of different metals. As a result, electric corrosion develops while adapting the adhered water, and so forth, to an electrolyte so that the functional degradation of the members, and so on, occurs and accordingly it becomes impossible to secure the durability or reliability of apparatuses, and the like. Hence, many electric-corrosion prevention measures have been proposed ever since conventionally.

35 **[0006]** Japanese Unexamined Patent Publication Gazette (KOKAI) No. 6-136,295, Japanese Unexamined Patent Publication Gazette (KOKAI) No. 2003-64,492, and Japanese Unexamined Patent Publication Gazette (KOKAI) No. 2003-253,481 disclose methods in which an insulative material is interposed between members of different metals so as not to contact the members of different metals with each other directly, thereby suppressing electric corrosion. Moreover, Japanese Unexamined Patent Publication (KOKAI) Gazette No. 6-287, 778 discloses a method in which a conductive painting material, which covers the boundary portion between members of different metals, which are disposed to neighbor to each other, is painted so that the members of different metals are short-circuited to each other electrically, thereby suppressing electric corrosion.

40 **[0007]** However, when an insulative member is interposed between members of different metals as disclosed in Japanese Unexamined Patent Publication Gazette(KOKAI) No. 6-136,295, and the like, in the instance that they are fastened with a bolt, and so forth, or by means of vibration, and so on, during service, there is a fear that the insulative member might be damaged so that defects might possibly be brought about. When defects generate, water, and the like, intrude through defective sections, and thereby electric corrosion develops. Further, in an apparatus such as compressors for which airtightness is required, since there is a possibility that pressure leakage takes place through defective
45 sections, it is not desired to use any intervening substance.

50 **[0008]** Moreover, in the method disclosed in Japanese Unexamined Patent Publication Gazette (KOKAI) No. 6-287,778, although it might be possible to short-circuit members of different metals to each other, it is difficult to say that it is a secure means for preventing electric corrosion because there is no such thought as preventing water, and the like, from permeating a painting material and then preventing it from intruding into the boundary portion between members of different metals.

DISCLOSURE OF THE INVENTION

55 **[0009]** The present invention is one which has been done in view of the aforementioned problematic points, and it is an object to provide a structural body and an electric-corrosion prevention method for the same, which can prevent the electric corrosion between members of different metals more effectively than having been done conventionally.

[0010] A structural body of the present invention, which solves the aforementioned problems, is characterized in that

a first member having a first outside end portion in which a first metal element is adapted to a major component; a second member having a second outside end portion in which a second metal element, being different from the first metal element, is adapted to a major component, and which is disposed to contact with the first outside end portion; and a coating member comprising a coated film, at least whose outside superficial portion is composed of a fluoropolymer substance, and coating at least a part of both first outside end portion and second outside end portion so as to cover the contact portion between them.

[0011] Moreover, an electric-corrosion prevention method of the present invention for structural bodies is characterized in that, in a structural body comprising: a first member having a first outside end portion in which a first metal element is adapted to a major component; a second member having a second outside end portion in which a second metal element, being different from the first metal element, is adapted to a major component, and which is disposed to contact with the first outside end portion; and a coating member comprising a coated film, at least whose outside superficial portion is composed of a fluoropolymer substance, and coating at least a part of both first outside end portion and second outside end portion so as to cover the contact portion between them, the development of electric corrosion, which might possibly occur so as to stride over the contact portion between the first outside end portion and the second outside end portion, is inhibited by hindering the electric conduction between said first outside end portion and said second outside end portion by means of said coating member.

[0012] In accordance with the structural body of the present invention and the electric-corrosion prevention method for the same, by means of the coating member with the aforementioned construction, the intrusion or adhesion of water, and the like, which connects between the first outside end portion and the second outside end portion electrically, can be prevented, and accordingly it is possible to prevent electric corrosion, which occurs so as to stride over the contact portion.

[0013] Further, since the aforementioned coating member can simply coat at least a part of both first outside end portion and second outside end portion so as to cover the contact portion between them, it is not necessary to interpose an intervening substance, such as insulative substances, between the first outside end portion and the second outside end portion.

[0014] Moreover, since the aforementioned coating member comprises a coated film, even if the structural member has a complicated configuration, it is possible to coat the coating member by means of ordinary paint application methods.

[0015] Here, the nominal terms, such as "first" and "second," are nothing but nominal terms for the sake of convenience for distinguishing members, and the like. For example, it does not matter whether either one of the first metal element and second metal element is an electrically base metal (metal with a lower reference potential) or a noble metal (metal with a higher reference potential). If distinguishing them daringly for the sake of convenience, it is advisable to adapt the first metal element to a base metal (Mg, for instance), and to adapt the second metal element to a noble metal (Fe, for instance).

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] With reference to the following detailed description and the accompanying drawings, the present invention can be understood more profoundly. Hereinafter, the brief description of the drawings will be done.

[0017] Fig. 1 is a diagram for schematically illustrating a test piece, which comprises members of different metals of an example and comparative examples, and is a side view in which the test piece is viewed from the outside surface. Moreover, Fig. 2 is a diagram for schematically illustrating the test piece, which comprises members of different metals of an example and comparative examples, and is a partially-enlarged cross-sectional view which cuts Fig. 1 axially.

[0018] Fig. 3 is a photograph, which was taken from the axial side while adapting a surface, which was equivalent to the contact portion of an Mg-alloy member in Example No. 1, to the front face, and is a photograph for substituting a drawing for showing the state of decay. Moreover, Fig. 4 is a photograph, which was taken from the axial side while adapting a surface, which was equivalent to the contact portion of an Mg-alloy member in Comparative Example No. 2, to the front face, and is a photograph for substituting a drawing for showing the state of decay.

[0019] Fig. 5 is a schematic diagram for explaining the development of electric corrosion in members of different metals.

BEST MODE FOR CARRYING OUT THE INVENTION

[0020] Hereinafter, the best mode for carrying out a structural body of the present invention and an electric-corrosion prevention method for the same will be explained, using Fig. 5.

[0021] A first member has a first outside end portion in which a first metal element is adapted to a major component, and a second member has a second outside end portion in which a second metal element, being different from the first metal element, is adapted to a major component. The first outside end portion and second outside end portion are such that, as far as they are composed of different metals, their configurations and material qualities do not matter. It is because, as far as they are different metals, electric corrosion might possibly occur between both of them more or less.

In particular, when the first metal element (or second metal element) is Mg, that is, when the first outside end portion is magnesium or a magnesium alloy, since electric corrosion is more likely to develop, the present invention is effective in this case. In this instance, there is not any limitation on the second metal element especially; although it can be any one of Al, Zn, Fe, Cu, and the like, among them, it is Fe, which has been used often in ordinary apparatuses, and by which a local cell is likely to be formed.

[0022] That is, it is sufficient that the first member and second member can be equipped with such outside end portions as described above. Namely, it is not necessary that the entirety is composed of a metallic material; for example, they can be composite members whose sections other than the outside end portions are made from resins, and the like. Moreover, both members are such that the forms or functions, and so forth, do not matter.

[0023] Although the second outside end portion is disposed to contact with the first outside end portion, either one of the contacting states, such as point contact, linear contact or planar contact, is allowable. Further, even when the first member does not contact with the second member directly, they can even be in states being united with a fastening tool, such as bolts, electrically. Moreover, as illustrated in Fig. 5, the end surfaces (11, 21) of both of them cannot be present on an identical plane, but can even protrude.

[0024] Note that the "outside end portion" referred to in the present invention is not one whose specific area is identified. It is because, depending on the forms of the members or the service environments, and the like, the range where electric corrosion might possibly occur differs. If referring to it daringly, it turns out to be regions that include at least the contact portion at which both of them contact.

[0025] As for the structural body of the present invention, compressors, engine blocks, hydraulic pumps, and the like, can be named. In particular, in a compressor, which comprises a front housing, a cylinder, and a rear housing, and in which a gasket is interposed between the cylinder and the rear housing, in the case of using a rear housing, in which Mg is adapted to a major component, and a gasket, in which Fe is adapted to a major component, if water droplets of rainwater, dew condensate, and so forth, adhere onto the outer peripheral surface so that electric corrosion develops, there is a possibility that pressure leakage occurs by means of the fact that the rear housing (Mg) is decayed, and accordingly this influences the compressor's performance greatly.

[0026] Here, a partially-enlarged cross-sectional diagram in the instance that a first outside end portion 10 of a first member 1 and a second outside end portion 20 of a second member 2 are disposed to contact with each other is shown in Fig. 5. In Fig. 5, for explanation, a metal constituting the first member 1 is adapted to magnesium, and a metal constituting the second member 2 is adapted to iron. Depending on environments in which this structural body is employed, on the outer peripheral sides (11, 21) of the first member 1 and second member 2, water droplets 4 of rainwater, dew condensate, and the like, might adhere in such a state that they stride over the contact portion 50 of both of them. Thus, a local cell is formed, local cell in which the first member 1 and second member 2, the members of different metals, are adapted to electrodes and the water droplets 4 are adapted to an electrolyte. And, from the end surface 11 of the first outside end portion 10, Mg whose decay potential is very low turns into Mn^{2+} to start eluting out into the water droplets 4. Namely, the electric corrosion of the first member 1, which is composed of magnesium, comes to develop. Of course, when the water droplets 4 intrude between the contact surfaces of the contact portion 50, too, similar electric corrosion develops.

[0027] The coating member of the present invention is one which inhibits the development of electric corrosion, which might possibly occur so as to stride over the contact portion between the first outside end portion and the second outside end portion, by hindering the electric conduction between the first outside end portion and the second outside end portion. That is, by means of the coating member, the continuation of the electrolyte, such as water, which connects between the first outside end portion and the second end portion, is canceled.

[0028] For that purpose, it is necessary that the coating member can comprise a coated film, at least whose outside superficial portion is composed of a fluoropolymer substance. Note that the "outside superficial portion" designates the superficial portion of the coating member onto which water, and the like, can adhere. That is, the outside superficial portion, when the coated film is a strip shape, for instance, includes not only the surfaces, which comprise the width-wise direction and length-wise direction of the strip, but also the thickness-wise-direction side surfaces. Further, the coating member is such that it is necessary that it can coat at least a part of both first outside end portion and second outside end portion so as to cover the contact portion between them.

[0029] Since the coated film, at least whose outside superficial portion is composed of a fluoropolymer substance, is such that at least the outside superficial portion is a coated film whose moisture permeability and water immersibility is low and which is of high density, it is possible to inhibit the intrusion or adhesion of water, and the like, by means of the coated film; as a result, the continuation of an electrolyte, which connects between both members electrically, is prevented. That is, it can prevent electric corrosion satisfactorily. Note that, in a coated film including a silicon-based polymer substance, such as silicone rubbers or silicone resins, since water permeates into the coated film, depending on the content of silicon, so that the continuation of an electrolyte, which connects between both members electrically, is formed within the contact portion or the coated film, it cannot suppress electric corrosion effectively.

[0030] Further, for the coating member, the adhesiveness to members of different metals is required as well. When

it is a coating member which is of high adhesiveness, it can prevent the intrusion of water, and the like, through the interface between members of different metals and the coating member. Accordingly, if the adhesiveness is poor only by the coating member, which is composed of a fluoropolymer substance, it is advisable to adapt it to a multi-layered structural member in which an undercoating layer, which can enhance the adhesiveness between both of them and prevent coming-off, is formed. Note that, although the higher the adhesiveness becomes the rougher the surface roughness of members of different metals is made, the rougher the surface roughness is the more likely it is that they are corroded electrically.

[0031] And, the coating member can preferably include a sealing layer, which is made by applying and then curing a fluorine-based sealing agent. This sealing layer can be either a single-layered construction or a multi-layered construction. A sealing layer, which is composed of a fluorine-based sealing agent is a coated film whose moisture permeability and water immersibility is low and which is of high density; and, even when being a single layer, it is good in terms of the adhesiveness to members of different metals, and accordingly it does not come off by means of vibration. Moreover, the heat resistance is satisfactory, too. Accordingly, the coating member, which includes the aforementioned sealing layer, is suitable for members of different metals, which are employed in apparatuses, such as compressors, which are employed under high-temperature conditions or in which vibrations generate during the apparatuses' service. Moreover, as for a fluorine-based sealing agent being adequate for a sealing layer of the coating member, although it is possible to name a fluorocarbon silicone rubber, and the like, it can preferably be a liquid fluorocarbon rubber especially.

[0032] The coating member is such that, although it depends on the type of fluoropolymer or the construction (single layer/multi layer) of the coating member, its sealing layer's thickness can be 100 μ m or more when using a fluorine-based sealing agent. When the thickness of a sealing layer is 100 μ m or more, it is sufficient to prevent the intrusion of water, and the like, and the effect of suppressing electric corrosion can be obtained satisfactorily.

[0033] The coating member is such that, as far as a portion, among the contact portion between the first outside end portion and the second outside end portion, portion onto which water, and the like, can adhere, is coated at least, there is not any limitation on its configuration and dimensions particularly. However, regarding the width of the coating member, although it depends on the configurations of members of different metals or the sizes of adhering water droplets, the width going over the contact portion can preferably be 10 mm or more. When the width of the coating member is 10 mm or more, even when water, and so forth, adheres, it is possible to get rid of the continuation of an electrolyte, such as water, which connects between the first outside end portion and the second outside end portion electrically, and accordingly it is possible to shut off or suppress the formation of local cell in which members of different metals are adapted to electrodes.

[0034] Note that, since the coating member is a coated film, it is possible to coat the coating member even when a objective section, among the members of different metals, on which the coating member is formed, is a portion which has a complicated configuration (for example, has a step at the contact portion as illustrated in Fig. 5). As for the forming method of a coated film, it can be obtained by applying a paint onto the objective section, drying it and then curing it by means of an ordinary paint application method, such as applying methods, flow-coating methods, spray-coating methods, spin-coating methods and roll-coating methods. In this instance, the drying condition, and the like, are such that, depending on the types of paints, it is advisable to select optimum conditions appropriately.

[0035] Note that the structural body of the present invention is not one which is limited to the above-described embodiment modes; but it is advisable to add another construction, such as forming a protective layer for protecting the coating member, for instance.

[0036] Moreover, the present invention can be grasped not only as the aforementioned structural body but also as an electric-corrosion prevention method for the same.

[0037] Hereinafter, an example of the structural body of the present invention and an electric-corrosion prevention method for the same will be explained, using Fig. 1 and Fig. 2. Note that Fig. 1 and Fig. 2 are diagrams for schematically illustrating a test piece, which comprises members of different metals; Fig. 1 is a side view in which the test piece is viewed from the outside surface; and Fig. 2 is a partially-enlarged cross-sectional view in which the test piece of Fig. 1 is cut axially.

[0038] [Example No. 1]

[0039] A test piece, which possessed members of different metals, was prepared. This test piece comprises an Mg-alloy member 1, and an Fe-alloy member 2. The Mg-alloy member 1 is 16 mm X 16 mm X 35 mm, is an AZ91 (JIS) Mg-alloy block, and is such that a screwed hole 16 extends in the longitudinal direction at its central portion. The Mg-alloy member 1 is such that a surface treatment (electrodeposition coating) was performed to the entire surface, and its surface roughness was $R_a = 0.11$ [μ m]. Moreover, the Fe-alloy member 2 is 16 mm X 16 mm X 16 mm, is a cold-rolled steel-plate SPCC (JIS) Fe-alloy block, and is such that a screwed hole 26, whose diameter is the same as that of the screwed hole 16, extends at its central portion.

[0040] And, a bolt 6 was screwed into the screwed holes 16, 26 of the aforementioned Mg-alloy member 1 and Fe-alloy member 2, thereby fastening them coaxially so as to contact with each other. As a result, a test piece was obtained, test piece which comprised rectangular-column-shaped members of different metals in which an outside end portion 10

of the Mg-alloy member 1 and an outside end portion 20 of the Fe-alloy member 2 contacted with each other so that end surfaces 11, 21 of the outside end portions 10, 20 were positioned on an identical plane.

[0041] And, onto the outer peripheral surface of the test piece, a coating member 3 was formed so as to cover a contact portion 50 between the outside end portion 10 of the Mg-alloy member 1 and the outside end portion 20 of the Fe-alloy member 2. Specifically, the coating member 3 covered the contact portion 50 by means of covering a part of the end surface 11 of the outside end portion 10 and a part of the end surface 21 of the outside end portion 20 in such a state that included a contact end portion 51, which existed linearly on the outer-peripheral-surface side of the test piece, among the contact portion 50 between the outside end portions 10 and 20.

[0042] The coating member 3 comprises a coated film of liquid fluorocarbon rubber ("SIFEL600" series produced by SIN-ETSU KAGAGU KOGYO Co., Ltd.). The liquid fluorocarbon rubber was applied onto the outer peripheral surface of the test piece so that the width (with the contact end portion 51 being adapted to the center) became 10 mm, and was made into a coated film, which was composed of a fluoropolymer substance being obtained by drying and curing it at 150°C for 1 hour. Moreover, the film thickness of the coating member 3 was 100-200 μm.

[0043] And, a member, which was obtained by the aforementioned procedure, was labeled Sample "A."

[0044] [Comparative Example No. 1]

[0045] By applying a commercially available silicone-based sealing agent onto the test piece of Example No. 1 as the coating member 3 and then drying and curing it at room temperature for 5 days, a coated film, which was similar to that of Example No. 1, was formed. An obtained member was labeled Sample "B."

[0046] [Comparative Example No. 2]

[0047] By applying a fluorine-containing silicone-resin-based paint onto the test piece of Example No. 1 as the coating member 3 and then drying and curing it at room temperature for 24 hours, a coated film, which was similar to that of Example No. 1, was formed. An obtained member was labeled Sample "C."

[0048] [Evaluation]

[0049] In order to evaluate the electric-corrosion prevention effects, a salt-water spraying test was carried out. The salt-water spraying test was carried out for 250 hours under such fixed conditions that a salt-water concentration: 5%, a spraying amount: 1-2 mL/hr., a spraying pressure: 0.098 ± 0.002 MPa, a testing temperature: 35 °C, and an air saturator: 47 °C.

[0050] After the test, the fastening between the Mg-alloy member 1 and the Fe-alloy member 2 was excluded, and then the appearance of the Mg-alloy member 1 was observed visually from the axial side while adapting the contact portion 50 to the front face. The results are set forth in Table 1. Note that Fig. 3 and Fig. 4, regarding Sample "A" and Sample "C," are photographs, which were taken from the axial side while adapting a surface, which was equivalent to the contact portion 50 of the Mg-alloy member 1 to the front face, and are photographs for substituting drawings for showing the states of decay.

[0051]

[TABLE 1]

Sample	State after Salt-water Spraying Test (Visual Observation)
Sample "A" (Ex. No. 1)	Satisfactory
Sample "B" (Comp. Ex. No. 1)	Decay Existed
Sample "C" (Comp. Ex. No. 2)	Large Decay Existed Locally

[0052] Samples "A"- "B," as illustrated in Fig. 1 and Fig. 2, are such that the coating member 3, which possesses a width with a certain extent, is coated sufficiently all over the entire periphery of the contact portion 51. Therefore, even when water droplets adhere onto the surface of the test piece, no electric conduction should be formed between the end surface 11 and the end surface 21 so that no electric corrosion should occur, either.

[0053] However, only Sample "A" was such that the appearance after the test was satisfactory, and decay occurred in Sample "B" and Sample "C." The coating member 3 of Sample "A" comprised a coated film, which was composed of a fluoropolymer substance, and could prevent the intrusion of salt water through the interfaces between the test pieces (1, 2) and the coating member 3, too, and through the surface of the coating member 3, too, effectively; as a result, it was possible to prevent the electric corrosion of the Mg-alloy member 1. On the contrary, with the coating member 3, which used the silicone-based sealing agent like Sample "B," it was not possible to prevent the intrusion of salt water. Further, in Sample "C," the fluorine-containing silicone-resin paint was employed; although a fluoropolymer substance was present in a part of the coating member 3, large decay was formed locally because salt water intruded partially through sections in which a silicone resin was present.

[0054] Note that, since the aforementioned members of different metals use the combination of alloys of the same

species as those for a compressor having a rear housing, in which Mg is adapted to a major component, and a gasket, in which Fe is adapted to a major component, for instance, it is needless to say that similar results are obtainable even when the evaluation is carried out, using the coating members set forth in the example and comparative examples for the aforementioned compressor.

Claims

1. A structural body, being **characterized in that** it comprises:

a first member having a first outside end portion in which a first metal element is adapted to a major component; a second member having a second outside end portion in which a second metal element, being different from the first metal element, is adapted to a major component, and which is disposed to contact with the first outside end portion; and

a coating member comprising a coated film, at least whose outside superficial portion is composed of a fluoropolymer substance, and coating at least a part of both first outside end portion and second outside end portion so as to cover the contact portion between them.

2. The structural body set forth in claim 1, wherein said coating member includes a sealing layer, which is made by applying a fluorine-based sealing agent and then curing it.

3. The structural body set forth in claim 2, wherein said sealing agent is a liquid fluorocarbon rubber.

4. The structural body set forth in claim 2, wherein said sealing layer is such that the thickness is 100 μm or more.

5. The structural body set forth in claim 1, wherein said coating member is such that the width, which goes over said contact portion, is 10 mm or more.

6. The structural body set forth in claim 1, wherein said first metal element or said second metal element is Mg.

7. The structural body set forth in claim 1, wherein said first metal element is Mg, and said second metal element is Fe.

8. The structural body set forth in claim 7, wherein said first member is a rear housing for a compressor, and said second member is a gasket therefor.

9. An electric-corrosion prevention method for structural bodies, being **characterized in that**, in a structural body comprising: a first member having a first outside end portion in which a first metal element is adapted to a major component; a second member having a second outside end portion in which a second metal element, being different from the first metal element, is adapted to a major component, and which is disposed to contact with the first outside end portion; and a coating member comprising a coated film, at least whose outside superficial portion is composed of a fluoropolymer substance, and coating at least a part of both first outside end portion and second outside end portion so as to cover the contact portion between them, the development of electric corrosion, which might possibly occur so as to stride over the contact portion between the first outside end portion and the second outside end portion, is inhibited by hindering the electric conduction between said first outside end portion and said second outside end portion by means of said coating member.

Fig.1

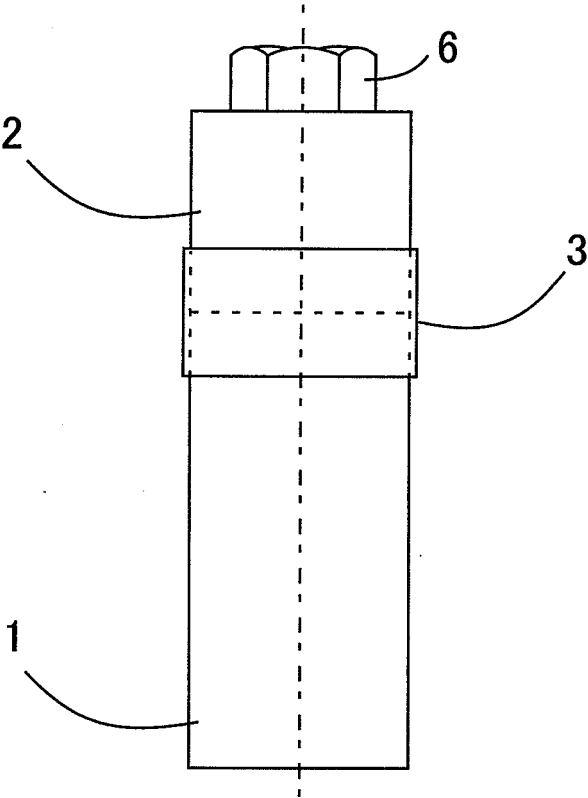


Fig.2

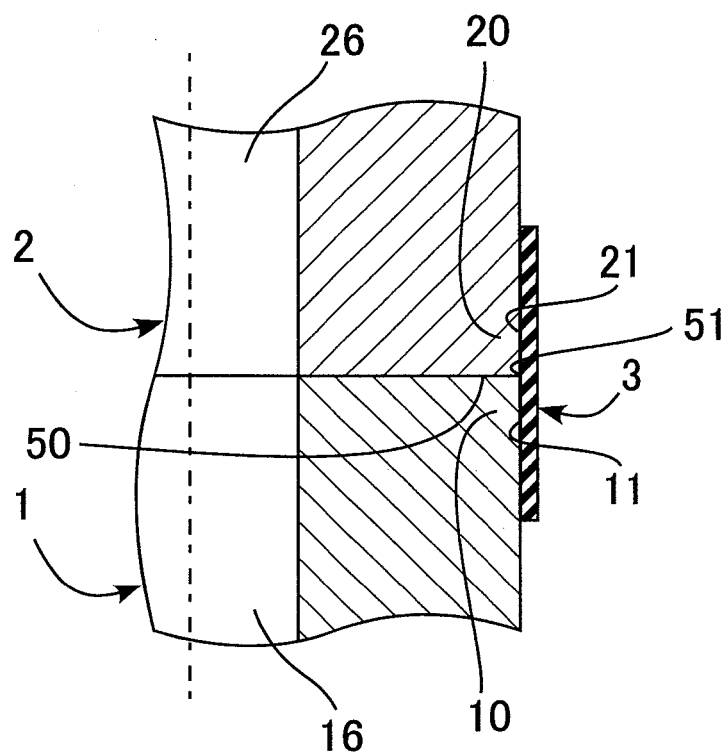


Fig.3

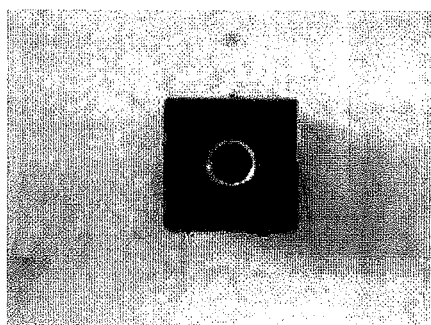


Fig.4

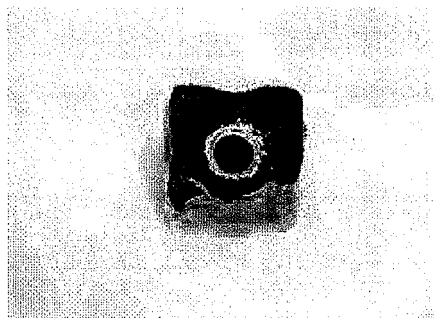
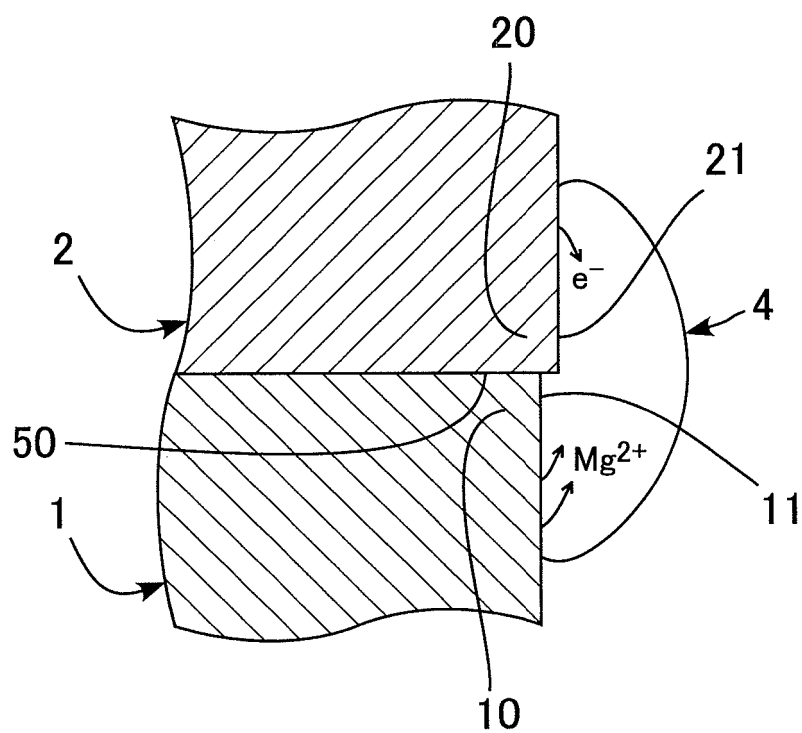


Fig.5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/009222

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ C23F15/00, F04B39/00 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ C23F15/00, F04B39/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 11-37296 A (Nippon Gasket Co., Ltd.), 12 February, 1999 (12.02.99), Column 2, lines 3 to 6; column 6, lines 31, 32, column 8, lines 22 to 31 & DE 19829656 A1 & US 6076833 A	1-5, 9 6-8
X Y	JP 5-92521 U (Nippon Drive Iit Kabushiki Kaisha), 17 December, 1993 (17.12.93), Claims; page 3, lines 18, 19; page 4, lines 3 to 5 (Family: none)	1, 5, 9 6, 7
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 17 August, 2005 (17.08.05)		Date of mailing of the international search report 30 August, 2005 (30.08.05)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-64492 A (Honda Motor Co., Ltd.), 05 March, 2003 (05.03.03), Claims; column 2, lines 1, 2 & WO 2003/018873 A1 & DE 10297130 A1 & US 2004206635 A1	6, 7
Y	JP 2002-357183 A (Toyota Industries Corp.), 13 December, 2002 (13.12.02), Claims & DE 10223962 A1 & US 2002178908 A1	8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6136295 A [0006] [0007]
- JP 2003064492 A [0006]
- JP 2003253481 A [0006]
- JP 6287778 A [0006] [0008]