Specification

NAME OF INVENTION: A repairing method for damage in an anticorrosion coating layer in a metal material

TECHNICAL FIELD

[0001]

The present invention relates to a repairing method for damage in an anticorrosion coating layer in a metal material which is coated by the anticorrosion coating layer composed of polyolefin.

BACKGROUND ART

[0002]

Polyolefin is widely used for anticorrosion coating in a metal material such as a steel tube since it is easy to process and is excellent in durability to moisture, soil, gas, and so on.

[0003]

A metal material is subjected to various physical impacts during storage, transportation, construction, or the like, and at such times, there is a case in which an anticorrosion coating layer of the metal material which is coated for anticorrosion with polyolefin is damaged. Since a damaged portion can be a cause of decrease of corrosion resistance, when damage occurs, it is required to be repaired. Regarding a repairing method for damage, various suggestions have been made.

[0004]

For example, several methods in which a portion where an anticorrosion coating layer is exposed is filled with a filling material (sealant), are known (Patent Documents 1 to 3).

[0005]

Patent Document 1 discloses a repairing method, in which, after filling a sealant showing thermal

meltability, or adherence and fluidity in an ordinary temperature in a damaged portion formed as a concave portion in an anticorrosion coating layer as to form its surface to be at the same level as the surface of the anticorrosion coating layer, a repairing material consisting of placing an adhesive layer on one surface of a cross-linked polyolefin sheet is bonded by heating in the damaged portion of the anticorrosion coating layer through the adhesive layer so as to coat the damaged portion and the surrounding anticorrosion coating layer of the damaged portion, and then a thermal meltable polyolefin sheet used for reinforcement having a softening point higher than the softening point of the adhesive used in the adhesive layer of the repairing material is bonded by heating so as to coat at least circumference of the repairing material and the anticorrosion coating layer in the vicinity of the circumference.

[0006]

Patent Document 2 discloses a repairing method, in which, a filling material is filled in a damaged portion of an anticorrosion steel material coated with polyethylene, a polyethylene sheet is covered so as to cover the filling material, and the polyethylene sheet is ultrasonically welded on a polyethylene coating film on the surface of the steel material.

[0007]

Patent Document 3 discloses a repairing method, in which, after applying a primer containing thermosetting resin exhibiting adhesiveness to polyolefin on at least a sealant contact scheduled surface of the surrounding polyolefin anticorrosion coating layer of an exposed surface of a steel tube, a sealant containing thermosetting resin exhibiting adhesiveness to a steel tube is applied to the sealant contact scheduled surface and the exposed surface of a steel tube, and then, after disposing a heat-shrinkable coating material coated with a

primer on one surface on at least a sealant layer so that a primer applied surface faces the sealant layer, and at the latest before termination of hardening reaction of the primer, the heat-shrinkable coating material is bonded on at least on the sealant layer while heating and heat-shrinking.

[0008]

In addition, methods in which a portion where an anticorrosion coating layer is exposed is repaired using a polyolefin sheet, are also known (Patent Documents 4 to 5).

[0009]

Patent Document 4 discloses a repairing method, in which, a modified polyethylene sheet is covered by heating-bonding on surfaces of a damaged portion of a mill-coated polyethylene coating layer of a steel material and the coating layer around the damaged portion, and then two-layer sheet (lower layer: modified polyethylene, upper layer: polyethylene) is covered by heating-bonding on a coating layer of the modified polyethylene.

[0010]

Patent Document 5 discloses a repairing method, in which, a primer containing an organometallic compound is applied to a damaged portion of a polyolefin coated steel material and a mill-coated polyolefin coating layer around it, and a primer is applied to one surface and a side surface of a polyolefin sheet used for repair having a shape to be fitted to the damaged portion, then an α-cyanoacrylate resin-based composition is applied to at least one of a primer applied surface of the damaged portion and the mill-coated polyolefin coating layer around it, and the polyolefin sheet used for repair is adhered to the damaged portion by opposing the primer applied surface.

[0011]

A metal material repaired by methods using a filling

material (sealant) such as Patent Documents 1 to 3, has a structure in which different materials (a filling material and polyolefin) are combined. Therefore, under an environment in which temperature of periphery of a metal material can increase, there is a concern of breakage of the repaired part due to a difference in thermal expansion rates.

In addition, in the cases of methods of using a polyolefin sheet such as Patent Documents 4 to 5, there is disadvantages that heating is necessary and that special materials are required as a primer or an adhesive, in order to sufficiently ensure adhesiveness between the polyolefin sheet and a ground metal material or the surrounding polyolefin anticorrosion coating layer.

[0012]

For this reason, development of a repairing method in which damage in an anticorrosion coating layer in a metal material can be repaired by a simple way and a repaired part is excellent in stability and durability, is desired.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0013]

Patent Document 1: JP S61-170586 A

Patent Document 2: JP 2001-129892 A

Patent Document 3: JP S61-193832 A

Patent Document 4: JP H1-95029 A

Patent Document 5: JP H1-275032 A

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0014]

The present invention has been accomplished in view of the above-mentioned background art. A problem to be solved by the present invention is to provide a repairing

method in which damage in an anticorrosion coating layer in a metal material can be repaired by a simple way (For example, even a non-skilled worker can repair.) and a repaired part is excellent in stability and durability.

MEANS FOR SOLVING THE PROBLEMS

[0015]

As a result of extensive studies to solve the above problems, the present inventor has found the following and has completed the present invention. That is, when repairing the anticorrosion coating layer by filling polyolefin sheets, which are the same material as the anticorrosion coating layer, by laminating and adhering polyolefin sheets as 2 or more sheet layers and by composing each sheet layer by joining more than one polyolefin sheet, uniform adhesion is easily done.

Besides, when each sheet layer is composed of more than one sheet in this way, there is a risk of penetration of liquid such as water from a seam between the sheets. By composing the seams not to overlap with each other in the vertically adjacent sheet layers, such a risk can be reduced and stability and durability of the repaired part can be ensured.

[0016]

That is, the present invention provides a repairing method for damage in an anticorrosion coating layer in a metal material which is coated by the anticorrosion coating layer composed of polyolefin,

wherein the repairing method has at least a step of forming a coating removed portion in which a coating removed portion where the metal material is exposed is formed by removing a damaged portion of the anticorrosion coating layer and a floating portion around the damaged portion, and a step of forming a filled portion in which filling polyolefin sheets used for filling, in the coating removed portion by laminating and adhering as 2 or more

sheet layers to form a filled portion of approximately the same height as that of an anticorrosion coating layer enclosing the coating removed portion,

wherein each of the sheet layers is composed of joining more than one polyolefin sheet used for filling together and has seams, and the seams do not overlap with each other in the adjacent sheet layers.

[0017]

Further, the present invention provides the above-mentioned repairing method, further having a step of forming a covering portion in which a polyolefin sheet used for covering is placed by adhesion on a boundary between the filled portion and an anticorrosion coating layer enclosing the filled portion, to form a covering portion which covers the boundary from above.

[0018]

It is noted that, in the present specification, there is a case in which a "polyolefin sheet" is abbreviated as a "sheet", a "polyolefin sheet used for filling" is abbreviated as a "sheet used for filling", and a "polyolefin sheet used for covering" is abbreviated as a "sheet used for covering", respectively.

EFFECTS OF THE INVENTION

[0019]

According to the present invention, a repairing method in which damage in an anticorrosion coating layer in a metal material can be repaired by a simple way and a repaired part is excellent in stability and durability, can be provided.

In particular, a metal material such as a steel tube to which the present invention is applied has many opportunities to be used in a place where moisture is large or under an environment exposed to chemicals. A metal material repaired by the method of the present invention can exhibit sufficient durability even in such a

place.

[0020]

In the method of the present invention, heating is not necessary when a polyolefin sheet is attached to the metal material. Therefore, repair can be performed even in a place or a situation where the fire must be avoided.

[0021]

In the method of the present invention, a sheet filled in a coating removed portion and an anticorrosion coating layer remaining around the coating removed portion are composed of the same polyolefin. Therefore, thermal expansion rates of both are in the same extent, and the repaired part is hard to break even under an environment in which temperature of periphery of the metal material can increase.

[0022]

In the method of the present invention, a sheet layer is composed of joining more than one sheet. Therefore, size of each sheet is relatively small. For this reason, there are various merits in the method of the present invention as compared with a case of repairing by filling one polyolefin sheet.

[0023]

First, in the method of the present invention, even if a worker is not skillful, a primer and an adhesive can be easy to be uniformly applied. In addition, the method of the present invention is easy to deal with various shapes of damage. In particular, if the metal material is a bent tube or a tower tank or the like, when damage is caused in a curved portion such as a bent portion or a branch portion, it is extremely difficult to uniformly apply the primer or the adhesive uniformly in a method of filling one polyolefin sheet. In contrast, the method of the present invention can easily perform repair of such a curved portion.

[0024]

In the method of the present invention, a filled portion is formed by laminating more than one sheet layer. For this reason, the present invention has various merits as compared with a case of forming a filled portion by one sheet layer.

[0025]

For example, there is various thickness in the anticorrosion coating layer in the metal material, and the present invention which use more than one sheet layer, can deal with anticorrosion coating layers with various thickness.

[0026]

In addition, in the present invention which use more than one sheet layer, even if a failure is caused in one layer of them, a ground metal material is hard to be influenced.

[0027]

Furthermore, under an environment in which temperature of periphery of a metal material can increase, due to difference in thermal expansion rates of the metal material and a polyolefin sheet, an adhesive layer between the metal material and the polyolefin sheet is easy to deteriorate, but when more than one sheet layer is laminated as in the present invention, there is no difference in thermal expansion rates of a sheet layer and another one, an adhesive layer between a sheet layer and another one is hardly to deteriorate.

[0028]

As described above, in the method of the present invention, more than one sheet layer is used and each of the sheet layers is composed of joining more than one sheet. Therefore, in the method of the present invention, repair is extremely easy, and it is possible to make stability and durability of a repaired part excellent.

BRIEF DESCRIPTION OF DRAWINGS

[0029]
[Figure 1] Figure 1 is a schematic cross-sectional view of a metal material.
[Figure 2] Figure 2 is a schematic cross-sectional view of vicinity of a damaged portion of an anticorrosion coating layer of a metal material.
[Figure 3] Figure 3 is a schematic cross-sectional view of a metal material after performing a step of forming a coating removed portion.
[Figure 4] Figure 4 is a plan view of a metal material after performing a step of forming a coating removed portion.
[Figure 5] Figure 5 is a plan view of a metal material after performing a step of forming a coating removed portion.
[Figure 6] Figure 6 is a schematic cross-sectional view of a metal material after performing a step of forming a filled portion.
[Figure 7] Figure 7 is a schematic cross-sectional view showing a process of a step of forming a filled portion.
(a) a state in which the first sheet layer is formed
(b) a state in which the second sheet layer is formed
(c) a state in which the third sheet layer is formed
[Figure 8] Figure 8 is a plan view showing a process of a step of forming a filled portion.
(a) a state in which the first sheet layer is formed
(b) a state in which the second sheet layer is formed
(c) a state in which the third sheet layer is formed
[Figure 9] Figure 9 is a plan view showing a process of a step of forming a filled portion.
(a) a state in which the first sheet layer is formed
(b) a state in which the second sheet layer is formed
(c) a state in which the third sheet layer is formed
[Figure 10] Figure 10 is a schematic cross-sectional view of a metal material after performing a step of forming a covering portion.

[Figure 11] Figure 11 is a plan view of a metal material after performing a step of forming a covering portion.
[Figure 12] Figure 12 is a schematic cross-sectional view of a metal material after performing a step of forming a covering portion.
[Figure 13] Figure 13 is a plan view of a metal material after performing a step of forming a covering portion.
[Figure 14] Figure 14 a schematic cross-sectional view showing a process of a step of forming a filled portion and a step of forming a covering portion (When a partially coating removed portion is formed in the step of forming a filled portion).
(a) a state in which the first sheet layer is formed
(a') a state in which the partially coating removed portion is formed after forming the first sheet layer
(b) a state in which the second sheet layer is formed
[Figure 15] Figure 15 is a subsequent view of Figure 14.
(b') a state in which the partially coating removed portion is formed after forming the second sheet layer
(c) a state in which the third sheet layer is formed
(d) a state in which the step of forming a covering portion is performed

EMBODIMENTS TO CARRY OUT THE INVENTION

[0030]

In the following, the present invention is explained, but the present invention is not limited by the following specific embodiments, and can be optionally changed.

[0031]

The present invention relates to a repairing method for damage in an anticorrosion coating layer 2 in a metal material 1 which is coated by the anticorrosion coating layer 2 composed of polyolefin. Figure 1 shows a schematic cross-sectional view of a metal material 1 before repair in the present invention. The metal

material 1 is coated with an anticorrosion coating layer 2 composed of polyolefin.

[0032]

There is no particular limitation on a type of a metals composing the metal material 1, and iron, aluminum, copper, zinc, steel, and so on, can be exemplified.

[0033]

There is no particular limitation on a shape of the metal material 1, and a metal plate, a metal tube, a metal rod, a metal container such as a tank, and so on, can be exemplified.

[0034]

When the metal material 1 is a metal tube, the metal tube may have the anticorrosion coating layer 2 on an inner surface, may have the anticorrosion coating layer 2 on an outer surface, and may have a metal layer on both the inner surface and the outer surface. The repairing method of the present invention is applicable to either anticorrosion coating layer 2 on the inner surface or the outer surface.

In addition, when the metal material 1 is a metal tube, the metal tube may a straight tube and may be a bent tube (a metal tube having a bent portion), a branched tube, a reducer tube, and so on.

[0035]

When the metal material 1 is a metal tube, there is no particular limitation on its inner diameter. The internal diameter of the metal tube is, for example, equal to or greater than 20cm, equal to or greater than 40cm, or equal to or greater than 50cm. And the internal diameter of the metal tube is, for example, equal to or less than 10m, equal to or less than 5m, or equal to or less than 3m.

[0036]

When the metal material 1 is a steel tube whose inner surface or outer surface, or both is coated by the

anticorrosion coating layer, in particular, when the steel tube is a steel tube for transporting liquid (water, chemicals and so on), there are many opportunities to damage is caused, and such a steel tube is widely applied. Therefore, the advantage of the present invention, that is, forming a repaired part with excellent stability and durability by a simple way, can be easily exerted.

[0037]

When the metal material 1 is a steel tube, more specifically, an electric resistance welded steel tube, a forged steel tube, a plated steel tube, a seamless steel tube, a spiral steel tube, a UOE steel tube, and so on, can be exemplified, but are not limited thereto.

[0038]

The anticorrosion coating layer 2 is composed of polyolefin and plays a role in protection of the metal material 1 against corrosion and impact.

[0039]

There is no particular limitation on polyolefin serving as a material of the anticorrosion coating layer 2, and low-density polyethylene, medium-density polyethylene, high-density polyethylene, polypropylene, polybutene, copolymers thereof, and so on, can be exemplified.

The anticorrosion coating layer 2 may be formed by using one type of them alone, or the anticorrosion coating layer 2 may be formed by two or more type thereof.

[0040]

Thickness (hereinafter, when referred to as "thickness" in this specification, it means an average thickness, unless otherwise specified) of the anticorrosion coating layer 2 is preferably equal to or greater than 0.5mm, more preferably equal to or greater than 1mm, particularly preferably equal to or greater than 1.2mm, and most preferably equal to or greater than 1.5mm. Besides, the thickness is preferably equal to or less than

5mm, more preferably equal to or less than 4.5mm, and particularly preferably equal to or less than 4mm.

When the thickness is equal to or greater than the above lower limit, it is excellent in corrosion resistance and impact resistance. When the thickness is equal to or less than the above upper limit, it is advantageous in terms of cost.

[0041]

In the repairing method of the present invention, first, a step of forming a coating removed portion is performed. In the step of forming a coating removed portion, a coating removed portion 23 where a metal material 1 is exposed is formed by removing a damaged portion 21 of the anticorrosion coating layer 2 and a floating portion 22 around the damaged portion 21.

[0042]

Figure 2 is a schematic cross-sectional view showing vicinity of the damaged portion 21 of the anticorrosion coating layer 2 of the metal material 1. The damaged portion 21 is generated due to contact with other materials during storage or transportation, contact with a tool during maintenance, and so on. It is possible to visually confirm that periphery of the damaged portion 21 is in a state of floating compared to the surface of the surrounding anticorrosion coating layer 2 (a state of being a floating portion 22) (It is noted that, the damaged portion 21 and the floating portion 22 are drawn exaggerated in Figure 2.).

[0043]

In a step of forming a coating removed portion, the damaged portion 21 and the floating portion 22 around the damaged portion 21 are removed.

Removal of the floating portion 22 can be performed by publicly known known methods such as those using cutters, scissors, powered tools, and so on.

[0044]

Figure 3 shows a schematic cross-sectional view of the metal material 1 after performing the step of forming a coating removed portion, and Figure 4 shows a plan view of that. A part where the damaged portion 21 and the floating portion 22 are removed is in a state in which the anticorrosion coating layer 2 is removed and the metal material 1 is exposed (a state of being a coating removed portion 23).

[0045]

In a step of forming a coating removed portion, the anticorrosion coating layer 2 of the damaged portion 21 and the floating portion 22 (i.e., a part which can be visually confirmed to be in a state of floating compared to the surface of the surrounding anticorrosion coating layer 2) is removed. The anticorrosion coating layer 2 may be removed with leeway (in surplus), including the anticorrosion coating layer 2 of the outside of the floating portion 22.

[0046]

In addition, when a shape of the coating removed portion 23 is a random shape as shown in Figure 4, in a step of forming a filled portion described later, the need to cut a standard polyolefin sheet in accordance with the shape of the coating removed portion 23 occurs. In order to reduce time and effort of such cutting, for example, a rectangular coating removed portion 23 as shown in Figure 5, may be formed by removing the anticorrosion coating layer 2 including the anticorrosion coating layer 2 of the outside of the floating portion 22.

[0047]

The area of the coating removed portion 23 is preferably equal to or greater than 50cm^2, more preferably equal to or greater than 75cm^2, and particularly preferably equal to or greater than 100cm^2. Besides, the area is preferably equal to or less than 500cm^2, more preferably equal to or less than 400cm^2, and particularly

preferably equal to or less than 300cm^2.

[0048]

In the repairing method of the present invention, after the step of forming a coating removed portion is performed, a step of forming a filled portion is performed. In the step of forming a filled portion, polyolefin sheets used for filling (31A, 32A and 33A) are filled in the coating removed portion 23 by laminating and adhering as 2 or more sheet layers (31, 32 and 33) to form a filled portion 3 of approximately the same height as that of the anticorrosion coating layer 2 enclosing the coating removed portion 23.

[0049]

Figure 6 shows a schematic cross-sectional view of the metal material 1 after performing the step of forming a filled portion. By performing the step of forming a filled portion, a site which was the coating removed portion 23, formed by removing the damaged portion 21 and the floating portion 22 around the damaged portion 21, becomes a state in which polyolefin sheets are filled.

[0050]

In the step of forming a filled portion, polyolefin sheets used for filling (31A, 32A and 33A) are laminated in the coating removed portion 23 as 2 or more sheet layers (31, 32 and 33). Each of the sheet layers (31, 32 and 33) is composed of joining more than one polyolefin sheet used for filling (31A, 32A and 33A) together and has seams, and the seams (31B, 32B and 33B) do not overlap with each other in the adjacent sheet layers.

[0051]

Figure 7, Figure 8 and Figure 9 show a specific example of a process of the step of forming a filled portion, using a case in which sheet layers laminated in the coating removed portion 23 are 3 layers as an example.

[0052]

First, the first sheet layer 31 is formed by

adhering the polyolefin sheets used for filling 31A on the metal material 1 which is exposed in the coating removed portion 23 (Figure 7(a), Figure 8(a) and Figure 9(a)).

As shown in Figure 8(a) and Figure 9(a), the first sheet layer 31 is composed of joining more than one polyolefin sheet used for filling 31A together, and seams 31B are formed between the sheet 31A and the sheet 31A.

[0053]

A standard (for example, a rectangular) polyolefin sheet which is commercially available or the like, can be used as the sheet 31, by cutting in accordance with the shape of the coating removed portion 23. In the step of forming a coating removed portion, when the shape of the coating removed portion 23 is formed, for example, in a rectangle as shown in Figure 5, the first sheet layer 31 also becomes rectangular as shown in Figure 9(a), and time and effort for cutting the sheets in the step of forming a filled portion can be reduced.

[0054]

After the first sheet layer 31 is formed, the second sheet layer 32 is formed by adhering the polyolefin sheets used for filling 32A thereon (Figure 7(b), Figure 8(b) and Figure 9(b)).

As shown in Figure 8(b) and Figure 9(b), the second sheet layer 32 is also composed of joining more than one polyolefin sheet used for filling 32A together, and seams 32B are formed between the sheet 32A and the sheet 32A.

[0055]

Here, the seams 32B in the second sheet layer 32 are formed so that they do not overlap with the seams 31B in the first sheet layer 31 (the adjacent sheet layer) (It is noted that, the seams 31B in the first sheet layer 31 are shown as dash-dotted lines in Figure 8(b) and Figure 9(b)).

Since the seams do not overlap with each other in the vertically adjacent sheet layers, when liquid such as

water is contacted to the filled portion 3, the liquid hardly penetrates into the lower sheet layer and thus to the metal material 1, and stability and durability of the repaired part improve.

[0056]

In order to more easily prevent the penetration of liquid such as water, positions of the seams of the vertically adjacent sheet layers (seams 32B and seams 31B) are better to be as far as possible. For example, as shown in Figure 8(b) and Figure 9(b), it is desirable to form the seams 32B around the middle position of the two seams 31B.

[0057]

After the second sheet layer 32 is formed, the third sheet layer 33 is formed by adhering the polyolefin sheets used for filling 33A thereon (Figure 7(c), Figure 8(c) and Figure 9(c)).

As shown in Figure 8(c) and Figure 9(c), the third sheet layer 33 is also composed of joining more than one polyolefin sheet used for filling 33A together, and seams 33B are formed between the sheet 33A and the sheet 33A.

[0058]

As in the second sheet layer 32, also in the third sheet layer 33, the seams 33B are formed so that they do not overlap with the seams 32B in the second sheet layer 32 (the adjacent sheet layer) (It is noted that, the seams 32B in the second sheet layer 32 are shown as dash-dotted lines in Figure 8(c) and Figure 9(c)).

[0059]

In order to more easily prevent the penetration of liquid such as water, positions of seams 33B and seams 32B are better to be as far as possible. For example, as shown in Figure 8(c) and Figure 9(c), it is desirable to form the seams 33B around the middle position of the two seams 32B. That is, the positions of the seams 33B of the third sheet layer 33 may be abbreviated identical to the

positions of the seams 31B of the first sheet layer 31.
[0060]

When the sheet layers are 3 layers, by forming the third sheet layer 33, a site which was the damaged portion 21 of the anticorrosion coating layer 2 of the metal material 1 and its periphery become a state in which the filled portion 3 is formed (Figure 6).
[0061]

The anticorrosion coating layer 2 is composed of polyolefin, and the filled portion 3 is formed by adhering polyolefin sheets used for filling. For this reason, thermal expansion rates of the filled portion 3 and the surrounding anticorrosion coating layer 2 are in the same extent, and the repaired part of the metal material repaired by the method of the present invention is hard to break even under an environment in which temperature of periphery of the metal material 1 can increase.
[0062]

Specific examples of polyolefin resin serving as a material of the anticorrosion coating layer 2 are as described above. It is desirable that polyolefin composing the anticorrosion coating layer 2 and polyolefin composing the polyolefin sheets used for filling (31A, 32A and 33A) are chemically identical. That is, it is desirable to select a polyolefin sheet which is chemically identical to polyolefin composing the anticorrosion coating layer 2 of the metal material 1 to which the present process is applied, and to use it as the polyolefin sheets used for filling (31A, 32A and 33A).

By this, breakage of the repaired part under an environment in which temperature of periphery of the metal material 1 can increase, is more easily prevented.
[0063]

In the step of forming a filled portion, polyolefin sheets used for filling are laminated as 2 or more sheet layers.

It is desirable that the number of sheet layers is two, three or four. When the sheet layers are 5 or more layers, there is a case in which working time is longer and there is a case in which stability and durability of the repaired part decrease due to many adhesion sites.

[0064]

In the step of forming a filled portion, a standard (for example, a rectangular) polyolefin sheet which is commercially available or the like, can be used by cutting if necessary.

[0065]

Thickness of the standard polyolefin sheet is preferably equal to or greater than 0.1mm, more preferably equal to or greater than 0.3mm, and particularly preferably equal to or greater than 0.5mm. Besides, the thickness is preferably equal to or less than 5mm, more preferably equal to or less than 4mm, and particularly preferably equal to or less than 3mm.

When the thickness is the above range, the number of sheet layers easy to be the desirable range described above.

[0066]

The area per the standard polyolefin sheet is preferably equal to or greater than 50cm^2, more preferably equal to or greater than 75cm^2, and particularly preferably equal to or greater than 100cm^2. Besides, the area is preferably equal to or less than 500cm^2, more preferably equal to or less than 400cm^2, and particularly preferably equal to or less than 300cm^2.

When the area is equal to or greater than the above lower limit, workability (working time) is easy to improve. When the area is equal to or less than the above upper limit, an adhesive and a primer can be evenly applied to the sheet, and peeling of the sheet hardly occurs.

[0067]

The standard polyolefin sheet is used cut in accordance with the shape of the coating removed portion 23. In particular, when a shape of the coating removed portion 23 is a random shape as shown in Figure 4, there is a case in which the area of sheet after cutting be below the above lower limit, but there is no particular problem.

[0068]

It is desirable that adhesion in the step of forming a filled portion is performed by applying a primer to the polyolefin sheets used for filling, drying the primer, and then applying an adhesive to the polyolefin sheets used for filling.

[0069]

The first sheet layer 31 is formed, by adhering the sheet 31A on the metal material 1 exposed in the coating removed portion 23. Applying a primer and an adhesive are applied to the sheet 31A rather than applying the primer or the adhesive to the metal material 1, uniform application is enabled and adhesiveness is easy to improve.

[0070]

Sheet layers after the second sheet layer are formed by adhering polyolefin sheets together. In this case, a primer and an adhesive may be applied to a polyolefin sheet composing an already-existing sheet layer, they may be applied to a polyolefin sheet to be newly placed, or they may be applied to both polyolefin sheets.

From a viewpoint of improving adhesiveness, it is desirable to apply the primer and the adhesive to both polyolefin sheets.

[0071]

Applying a primer to an adherend surface such as a polyolefin sheet earlier than applying an adhesive, adhesiveness between the adherend surface and the adhesive becomes satisfactory.

As specific examples of the primer used in the step of forming a filled portion, an amine-based primer, a synthetic rubber-based primer, an acrylic primer, a urethane-based primer, an epoxy-based primer, and so on, can be exemplified.

One type of these primers may be used alone, or two or more type thereof may be used. From a viewpoint of work efficiency, it is desirable to use one type of these primers is used alone.

[0072]

Amount of application of the primer used in the step of forming a filled portion is preferably equal to or greater than 0.1g/m^2, more preferably equal to or greater than 0.5g/m^2, and particularly preferably equal to or greater than 1.0g/m^2. Besides, the amount is preferably equal to or less than 6.0g/m^2, more preferably equal to or less than 3.0g/m^2, and particularly preferably equal to or less than 2.0g/m^2.

When the amount is equal to or greater than the above lower limit, workability (working time) is easy to improve, and it is advantageous in terms of cost. When the amount is equal to or less than the above upper limit, adhesiveness is easy to improve.

[0073]

Timing at which the adhesive is applied, that is, time interval after completion of application of the primer before starting application of the adhesive, is preferably is preferably equal to or longer than 0.5minutes, more preferably equal to or longer than 1minute, and particularly preferably equal to or longer than 2minute. Besides, the time interval is preferably equal to or shorter than 10minute, more preferably equal to or shorter than 7minute, and particularly preferably equal to or shorter than 5minute.

[0074]

As specific examples of the adhesive used in the

step of forming a filled portion, polyvinyl acetate-based adhesive, cyanoacrylate-based adhesive, cellulose-based adhesive, polyester-based adhesive, polyether-based adhesive, polyamide-based adhesive, polyimide-based adhesive, epoxy-based adhesive, urethane-based adhesive, rubber-based adhesive, silicone-based adhesive, and so on, can be exemplified.

One type of these adhesives may be used alone, or two or more type thereof may be used. From a viewpoint of work efficiency, it is desirable to use one type of these adhesives is used alone.

[0075]

Amount of application of the adhesive used in the step of forming a filled portion is preferably equal to or greater than 20g/m^2, more preferably equal to or greater than 30g/m^2, and particularly preferably equal to or greater than 40g/m^2. Besides, the amount is preferably equal to or less than 70g/m^2, more preferably equal to or less than 60g/m^2, and particularly preferably equal to or less than 50g/m^2.

When the amount is equal to or greater than the above lower limit, workability (working time) is easy to improve, and it is advantageous in terms of cost. When the amount is equal to or less than the above upper limit, adhesiveness is easy to improve.

[0076]

In the step of forming a filled portion, earlier than placing the polyolefin sheets, it is desirable to perform roughening of the surface of the metal material 1 which is exposed in the coating removed portion 23 using sand paper or the like in order to improve adhesiveness. In addition, it is desirable to remove rust and foreign matters from the surface of the metal material 1 after roughening is performed, by cleaning with a solvent such as acetone, and a waste cloth or the like.

Further, in the step of forming a filled portion, it

is desirable to perform roughening and cleaning for the polyolefin sheet to be placed on the coating removed portion 23 in the same manner. From a viewpoint of work efficiency and a viewpoint of adhesiveness, it is particularly desirable to perform roughening and cleaning in advance on both surfaces of the polyolefin sheets before placing.

[0077]

In the repairing method of the present invention, after the step of forming a filled portion is performed, a step of forming a covering portion may be performed.

In the step of forming a covering portion, a polyolefin sheet used for covering 41 is placed by adhesion on a boundary 34 between the filled portion 3 and the anticorrosion coating layer 2 enclosing the filled portion 3, to form a covering portion 4 which covers the boundary 34 from above (Figure 10 and Figure 12).

[0078]

In the filled portion 3 of the metal material 1 after performing the step of forming a filled portion (Figure 6), since the seams do not overlap with each other in the vertically adjacent sheet layers, liquid such as water hardly penetrates into the lower sheet layer and thus to the metal material 1. However, there is a case in which via the boundary 34 between the filled portion 3 and the anticorrosion coating layer 2 enclosing the filled portion 3, liquid such as water penetrates into the metal material 1.

By performing the step of forming a covering portion, the boundary 34 is covered from above, penetration of liquid such as water is more easily prevented.

[0079]

In the step of forming a covering portion, the polyolefin sheet used for covering 41 is placed by adhesion on a boundary 34 between the filled portion 3 and

the anticorrosion coating layer 2.

In the step of forming a covering portion, the covering portion 4 may be formed by covering the filled portion 3 (the uppermost sheet layer) and the boundary 34 using one polyolefin sheet used for covering 41 as shown in Figure 10 and Figure 11, and filled portion 3 (the uppermost sheet layer) may partly not be covered by covering only necessary part for covering the boundary 34 using more than one polyolefin sheets used for covering 41 as shown in Figure 12 and Figure 13.

In addition, a shape of the polyolefin sheets used for covering 41 is not necessarily to be rectangular as shown in Figure 11 and Figure 13 and may be a random shape or the like, as long as it can cover the boundary 34.

[0080]

Thickness of the polyolefin sheet used for covering 41 is preferably equal to or greater than 0.1mm, more preferably equal to or greater than 0.3mm, and particularly preferably equal to or greater than 0.5mm. Besides, the thickness is preferably equal to or less than 5mm, more preferably equal to or less than 4mm, and particularly preferably equal to or less than 3mm.

When the thickness is the above range, the number of sheet layers easy to be the desirable range described above.

[0081]

When using one polyolefin sheet used for covering 41 as shown in Figure 10 and Figure 11, the area of the polyolefin sheet used for covering 41 is preferably equal to or greater than 100cm^2, more preferably equal to or greater than 150cm^2, and particularly preferably equal to or greater than 200cm^2. Besides, the area is preferably equal to or less than 1000cm^2, more preferably equal to or less than 800cm^2, and particularly preferably equal to or less than 600cm^2.

[0082]

When using more than one polyolefin sheets used for covering 41 as shown in Figure 12 and Figure 13, the area per the polyolefin sheet used for covering 41 is preferably equal to or greater than 50cm^2, more preferably equal to or greater than 75cm^2, and particularly preferably equal to or greater than 100cm^2. Besides, the area is preferably equal to or less than 500cm^2, more preferably equal to or less than 400cm^2, and particularly preferably equal to or less than 300cm^2.

[0083]

It is also desirable that adhesion in the step of forming a covering portion is performed by applying a primer to the polyolefin sheet used for covering 41, drying the primer, and then applying an adhesive to the polyolefin sheet used for covering 41.

[0084]

In adhesion in the step of forming a covering portion, a primer and an adhesive may be applied to the uppermost polyolefin sheets used for filling (33A in the case shown in Figure 7, Figure 8 and Figure 9(a)), they may be applied to the polyolefin sheet used for covering 41, or they may be applied to both polyolefin sheets.

From a viewpoint of improving adhesiveness, it is desirable to apply the primer and the adhesive to both polyolefin sheets.

[0085]

Specific examples of the primer and the adhesive used in the step of forming a covering portion, preferable amount of application of them, and preferable time interval after completion of application of the primer before starting application of the adhesive are the same as those described in the step of forming a filled portion described above.

[0086]

It is desirable to perform roughening on only one surface of the polyolefin sheet used for covering 41 used

in the step of forming a covering portion and to use the surface on which roughening is performed as an adherend surface with the filled portion 3 and the anticorrosion coating layer 2 (It is meaningless to perform roughening on the surface of the polyolefin sheet used for covering 41 which is not the adherend surface).

[0087]

In the step of forming a filled portion in the present invention, before forming the second sheet layer or subsequent sheet layer, a partially coating removed portion 24, where the anticorrosion coating layer 2 around the sheet layer below is removed so as to be approximately the same height as that of the "sheet layer below", may be formed.

Figure 14 and Figure 15 show a specific example of a process of such a process.

[0088]

Formation of the first sheet layer 31 is the same as that shown in Figure 7(a) (Figure 14(a)).

[0089]

After forming the first sheet layer 31, the anticorrosion coating layer 2 around the sheet layer 31 is removed to form the partially coating removed portion 24 (Figure 14(a')). At this time, the anticorrosion coating layer 2 is removed so that the height of the anticorrosion coating layer 2 below the partially coating removed portion 24 is approximately the same as the height of the first sheet layer 31.

[0090]

After forming the partially coating removed portion 24, the second sheet layer 32 is formed on the first sheet layer 31 (Figure 14(b)). When forming the second sheet layer 32, the polyolefin sheets used for filling 32A is filled so as to include the partially coating removed portion 24.

It is the same as the case shown in Figure 7(b) that

the seams 32B in the second sheet layer 32 and the seams 31B in the first sheet layer 31 do not overlap.

[0091]

After forming the second sheet layer 32, in the same manner, the anticorrosion coating layer 2 around the second sheet layer 32 is removed to form the partially coating removed portion 24 (Figure 15(b')). Next, the polyolefin sheets used for filling 33A is filled so as to include the partially coating removed portion 24 to form the third sheet layer 33 (Figure 15(c)).

[0092]

After forming the third sheet layer 33 (i.e. completing the step of forming a filled portion), the step of forming a covering portion may be performed (Figure 15(d)).

[0093]

In the step of forming a filled portion, by forming the partially coating removed portion 24 before forming the second sheet layer or subsequent sheet layer, as shown in Figure 15(c) and Figure 15(d), a shape of the filled portion 3 becomes mortar-shaped.

By this, the boundary 34 between the filled portion 3 and the anticorrosion coating layer 2 enclosing the filled portion 3 is not straight, penetration of liquid from the boundary 34 can be more effectively prevented.

INDUSTRIAL APPLICABILITY

[0094]

The present invention can provide a repairing method in which damage in an anticorrosion coating layer in a metal material can be repaired by a simple way and a repaired part is excellent in stability and durability. The metal material repaired by the repairing method of the present invention is widely utilized for the repair of steel tubes or the like, composing a water tube for transporting such as water supply and sewage, agricultural

water and industrial water; a pipe for chemicals and cooling water in a factory, a plant and so on; a pipeline for transporting such as gas, electric and petroleum; and so on.

REFERENCE SIGNS LIST

[0095]

1: metal material
2: anticorrosion coating layer
3: filled portion
4: covering portion
21: damaged portion
22: floating portion
23: coating removed portion
24: partially coating removed portion
31: sheet layer (first layer)
31A: polyolefin sheets used for filling (first layer)
31B: seam (first layer)
32: sheet layer (second layer)
32A: polyolefin sheets used for filling (second layer)
32B: seam (second layer)
33: sheet layer (third layer)
33A: polyolefin sheets used for filling (third layer)
33B: seam (third layer)
34: boundary
41: polyolefin sheet used for covering

Claims

1. A repairing method for damage in an anticorrosion coating layer in a metal material which is coated by the anticorrosion coating layer composed of polyolefin,

wherein the repairing method has at least a step of forming a coating removed portion in which a coating removed portion where the metal material is exposed is formed by removing a damaged portion of the anticorrosion coating layer and a floating portion around the damaged portion, and a step of forming a filled portion in which filling polyolefin sheets used for filling, in the coating removed portion by laminating and adhering as 2 or more sheet layers to form a filled portion of approximately the same height as that of an anticorrosion coating layer enclosing the coating removed portion,

wherein each of the sheet layers is composed of joining more than one polyolefin sheet used for filling together and has seams, and the seams do not overlap with each other in the adjacent sheet layers.

2. The repairing method according to Claim 1, further having a step of forming a covering portion in which a polyolefin sheet used for covering is placed by adhesion on a boundary between the filled portion and an anticorrosion coating layer enclosing the filled portion, to form a covering portion which covers the boundary from above.

3. The repairing method according to Claim 1 or 2, wherein adhesion in the step of forming a filled portion is performed by applying a primer to the polyolefin sheets used for filling, drying the primer, and then applying an adhesive to the polyolefin sheets used for filling.

4. The repairing method according to Claim 1 or 2,

wherein polyolefin composing the anticorrosion coating layer and polyolefin composing the polyolefin sheets used for filling are chemically identical.

5. The repairing method according to Claim 1 or 2, wherein thickness of the anticorrosion coating layer is equal to or greater than 0.5mm and equal to or less than 5mm.

6. The repairing method according to Claim 1 or 2, wherein the metal material is a steel tube whose inner surface or outer surface, or both is coated by the anticorrosion coating layer.

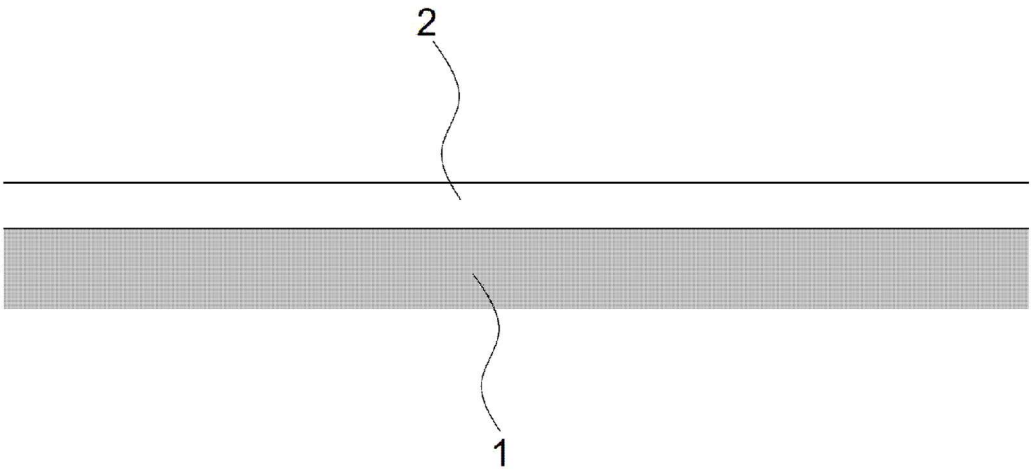
7. The repairing method according to Claim 6, wherein the steel tube is a steel tube for transporting liquid.

Abstract

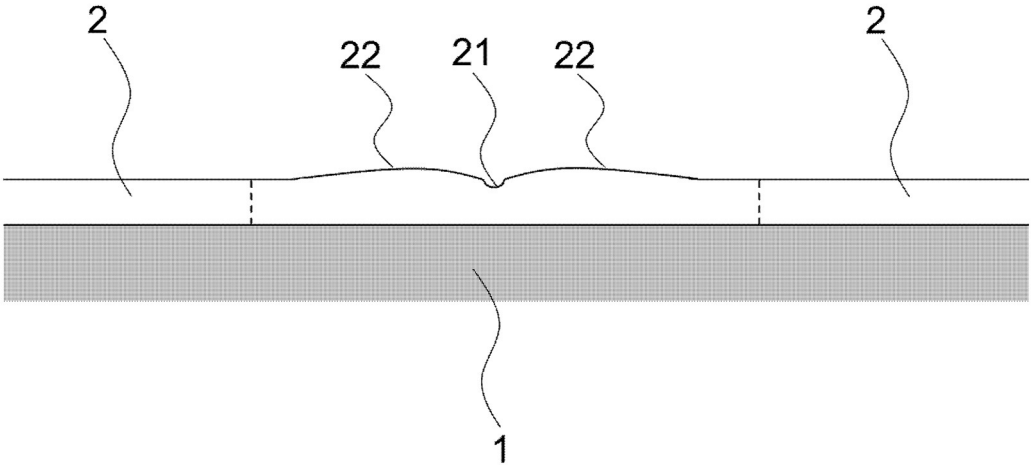
The present invention provides a repairing method in which an anticorrosion coating layer 2 in a metal material 1 can be repaired by a simple way and a repaired part is excellent in stability and durability.

The repairing method of the present invention has at least a step of forming a coating removed portion in which a coating removed portion 23 where the metal material 1 is exposed is formed by removing a damaged portion 21 of the anticorrosion coating layer 2 and a floating portion 22 around the damaged portion 21, and a step of forming a filled portion in which filling polyolefin sheets used for filling (31A, 32A and 33A), in the coating removed portion 23 by laminating and adhering as 2 or more sheet layers (31, 32 and 33) to form a filled portion of approximately the same height as that of an anticorrosion coating layer 2 enclosing the coating removed portion 23. Each of the sheet layers is composed of joining more than one polyolefin sheet used for filling together and has seams (31B, 32B and 33B), and the seams do not overlap with each other in the adjacent sheet layers.

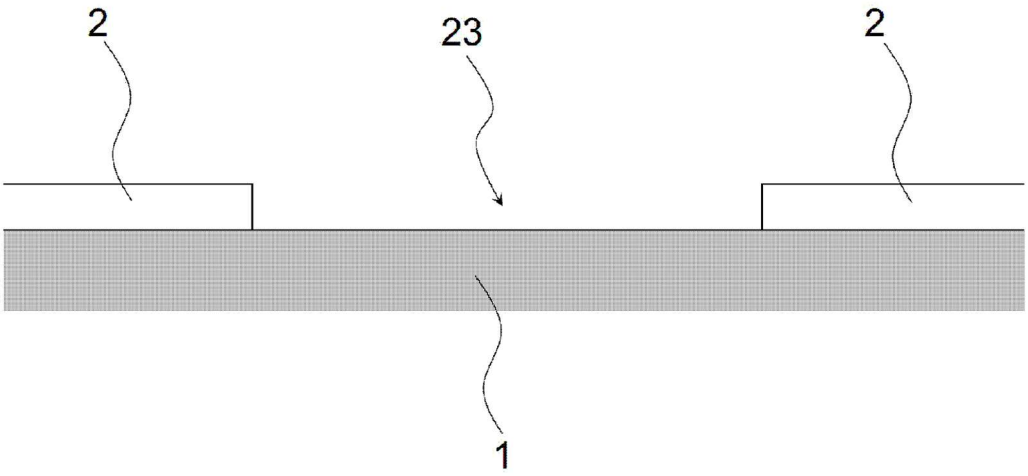
[Figure 1]



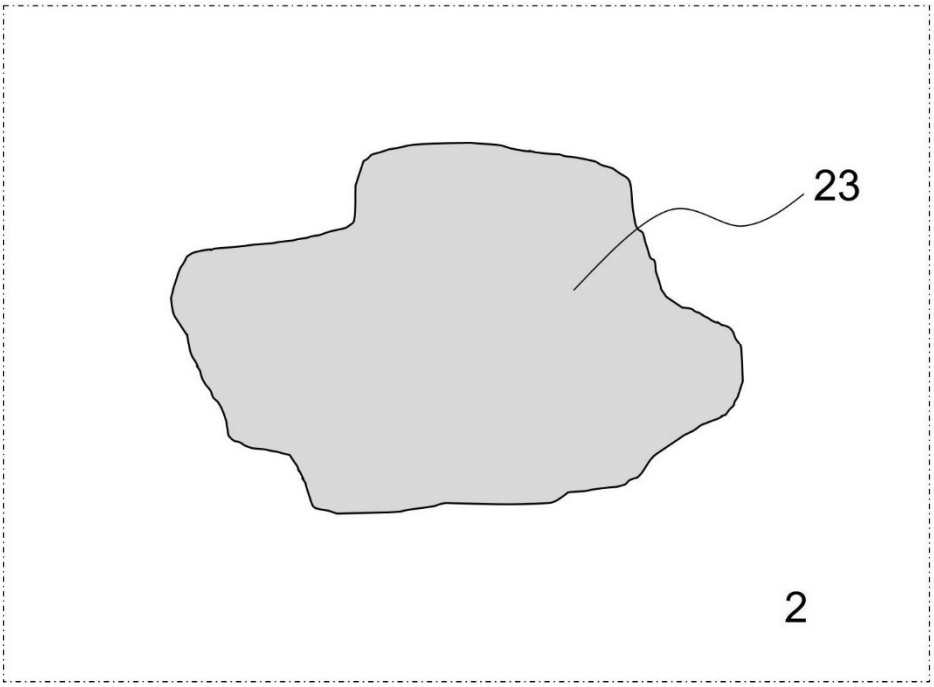
[Figure 2]



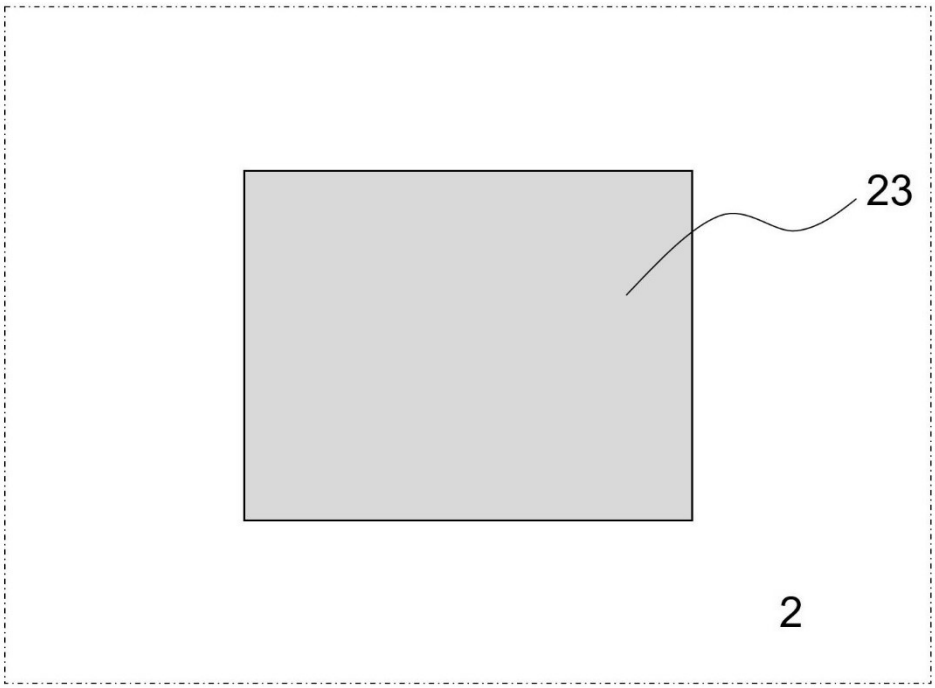
[Figure 3]



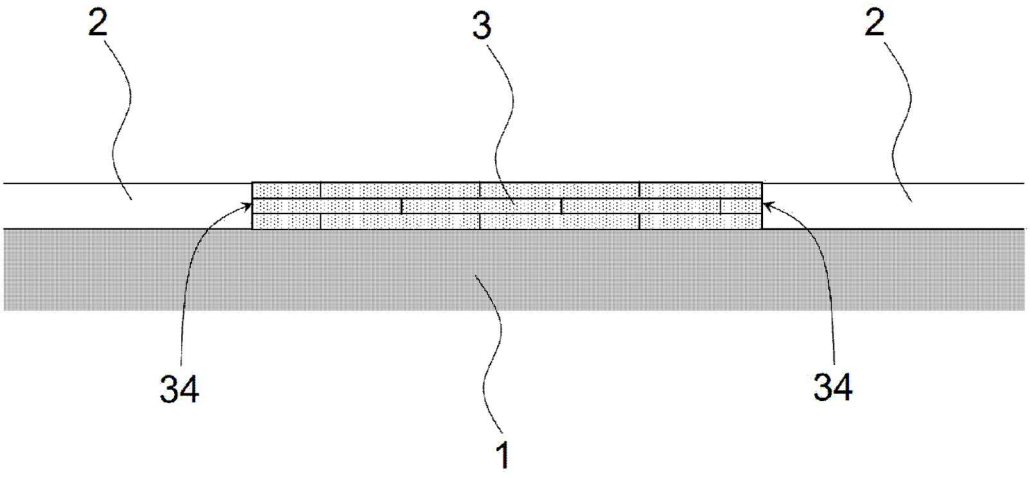
[Figure 4]



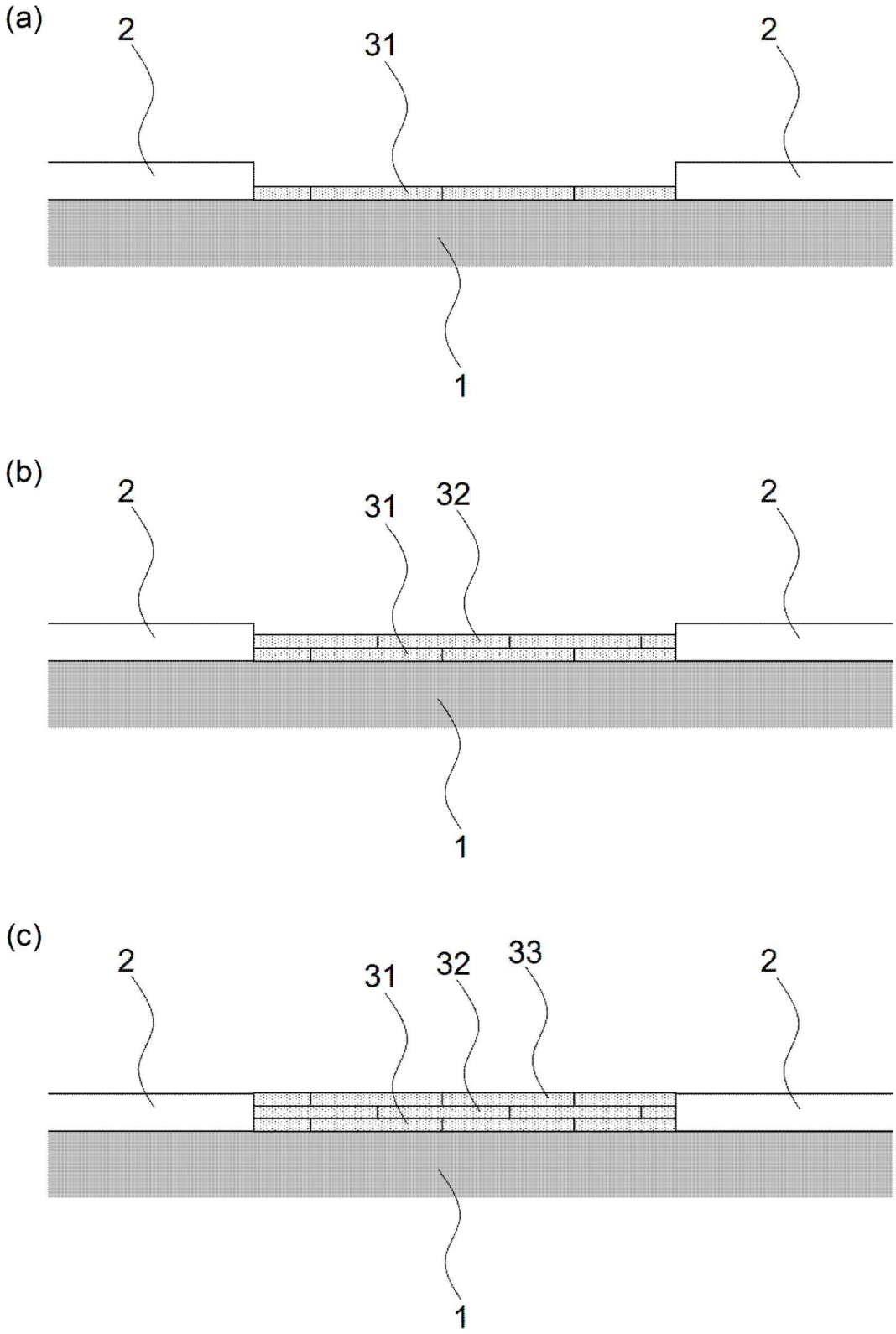
[Figure 5]



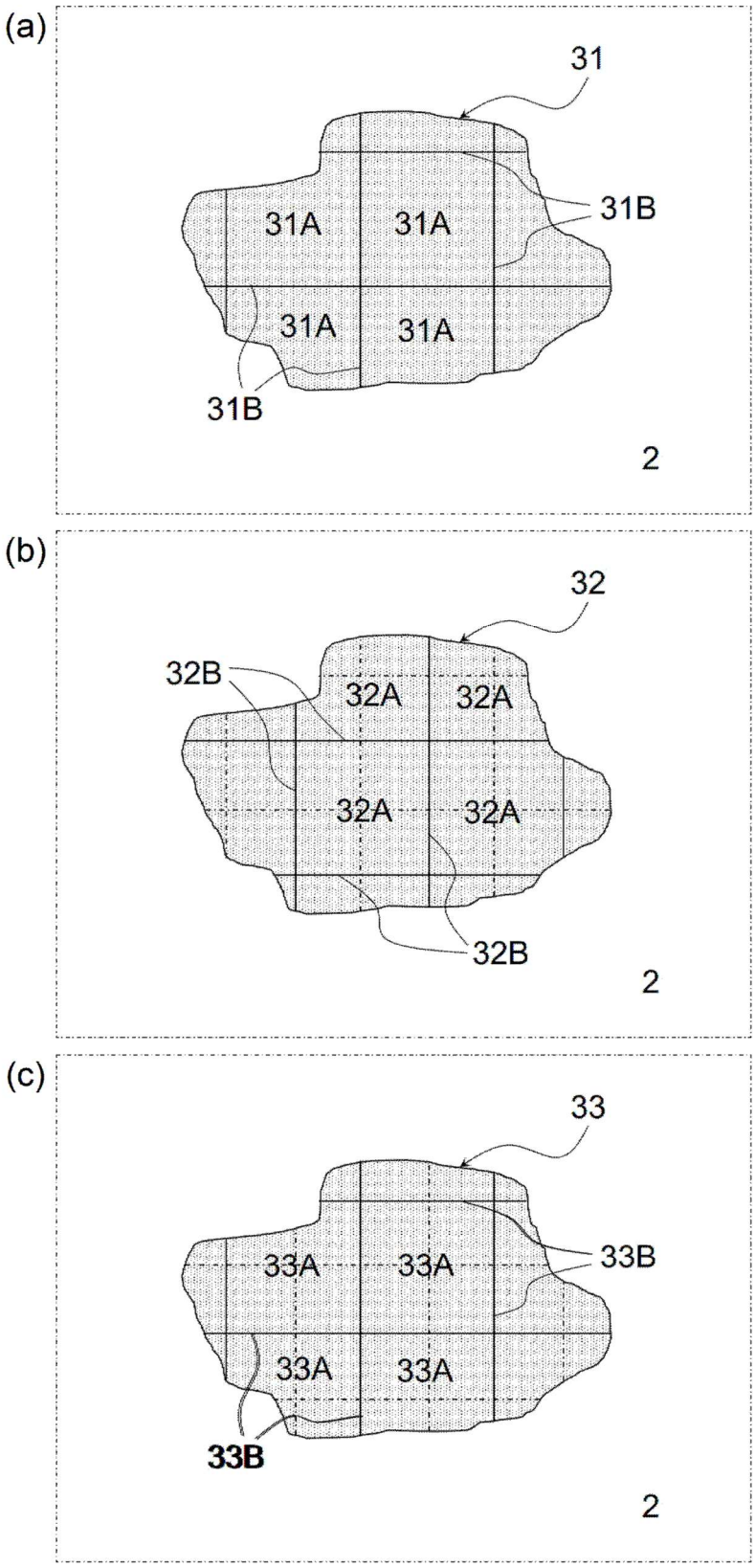
[Figure 6]



[Figure 7]



[Figure 8]


(a)
31
31A
31A
31B
31A
31A
31B
2
(b)
32
32B
32A
32A
32A
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(c)
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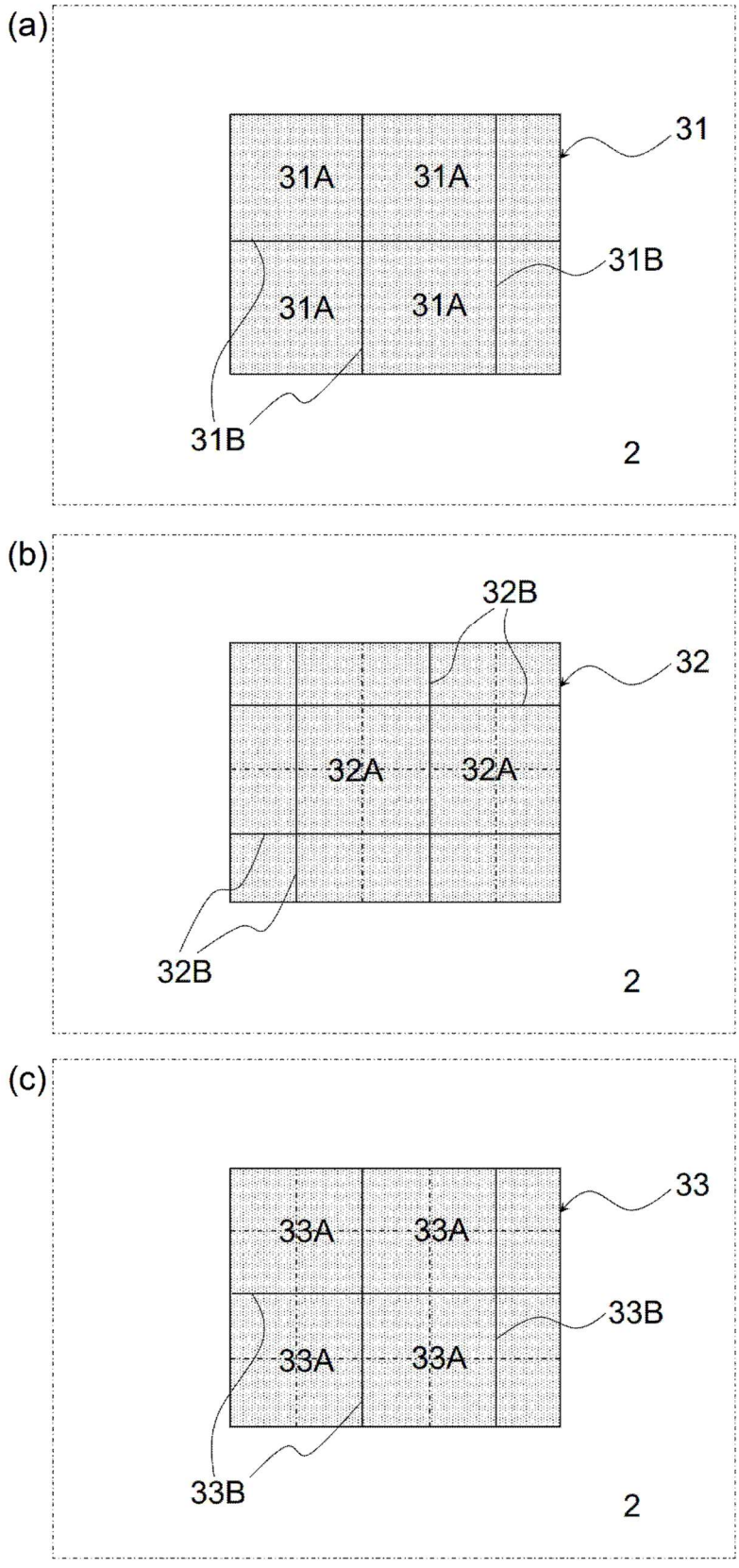
33A
33A
33B
33A
33A
33B
2

[Figure 9]


(a)
31
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(b)
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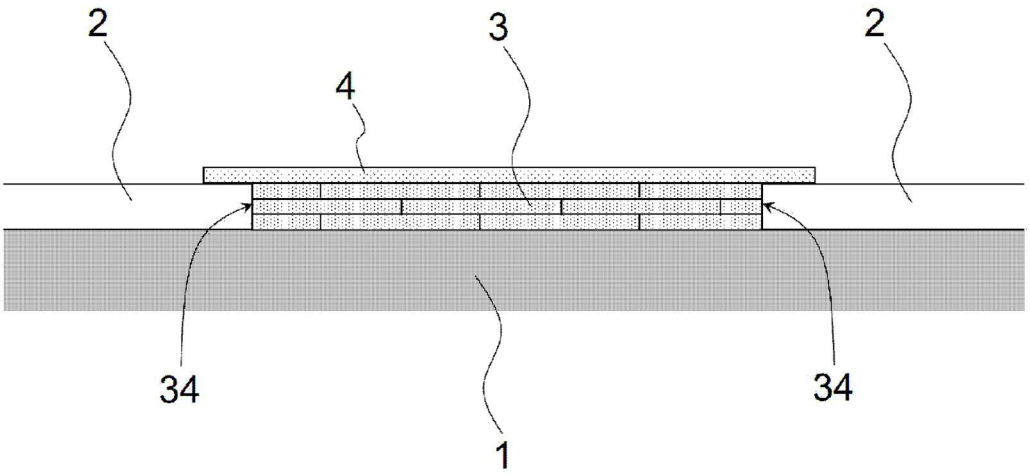
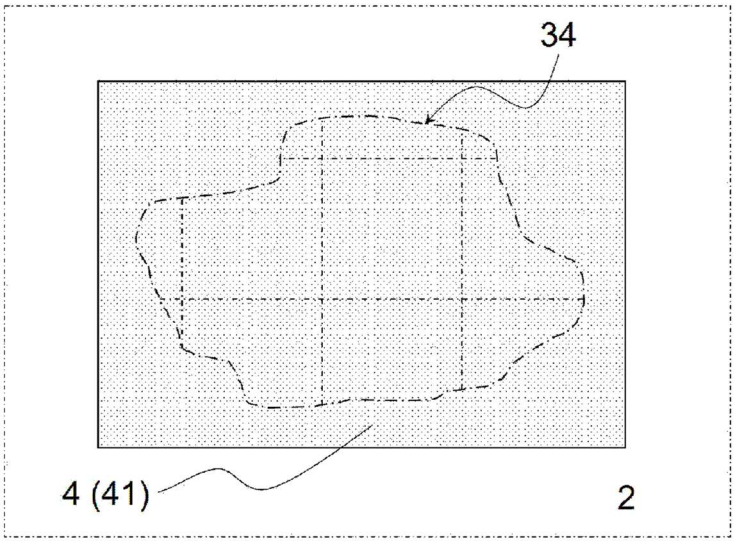
33B
2

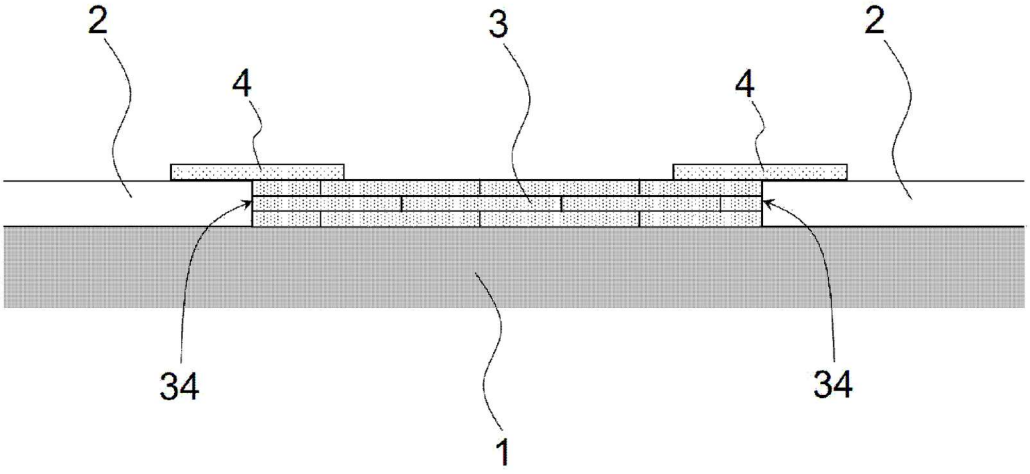
[Figure 10]



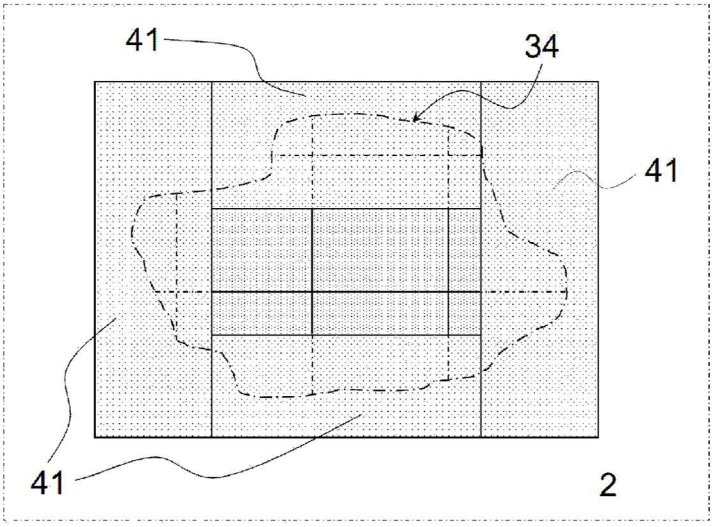
[Figure 11]



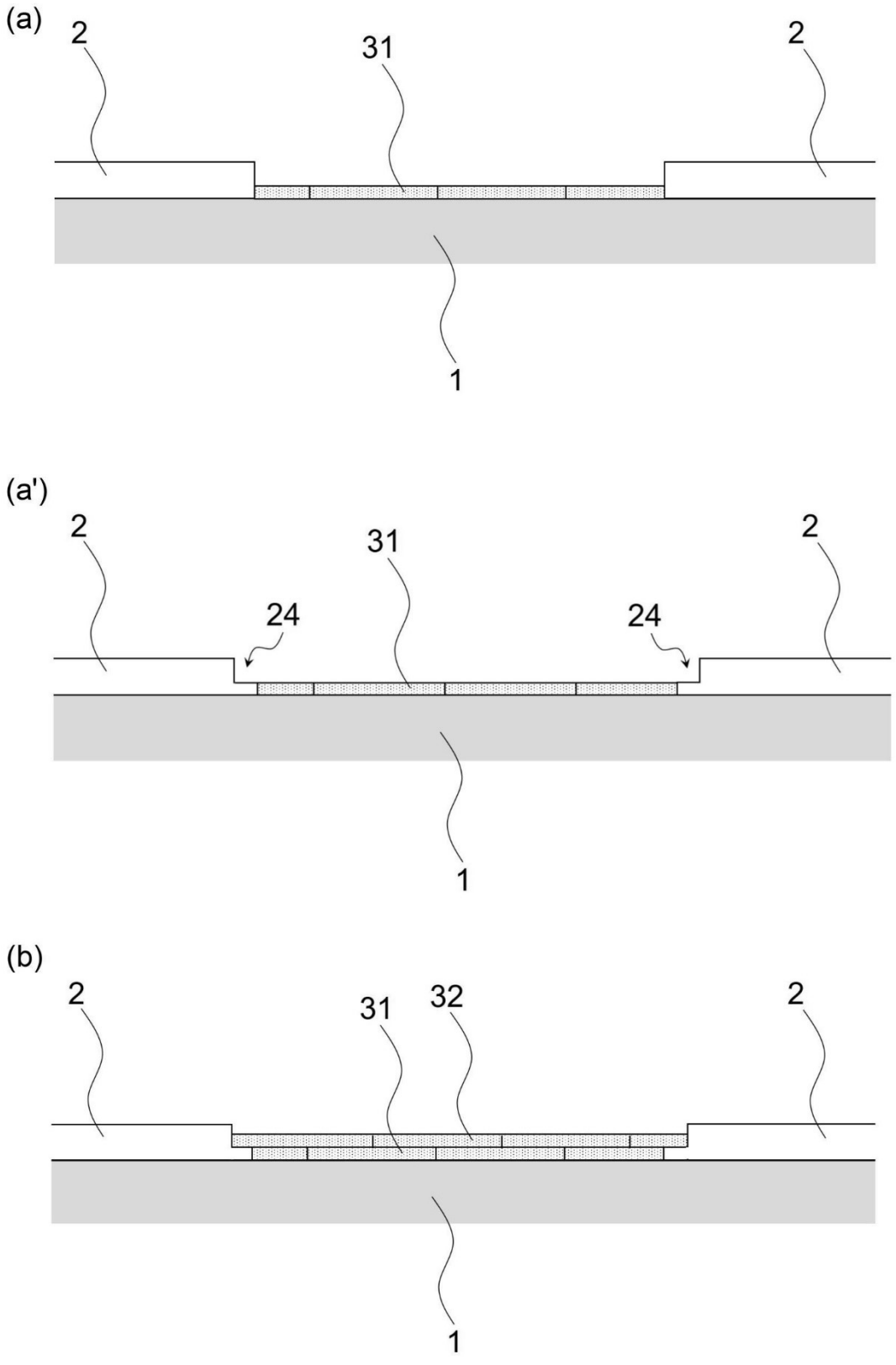
[Figure 12]



[Figure 13]

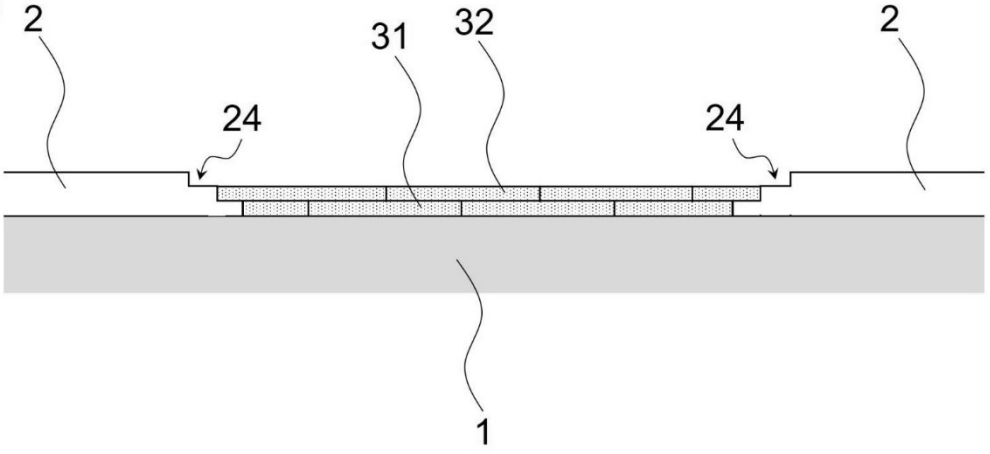


[Figure 14]



[Figure 15]

(b')



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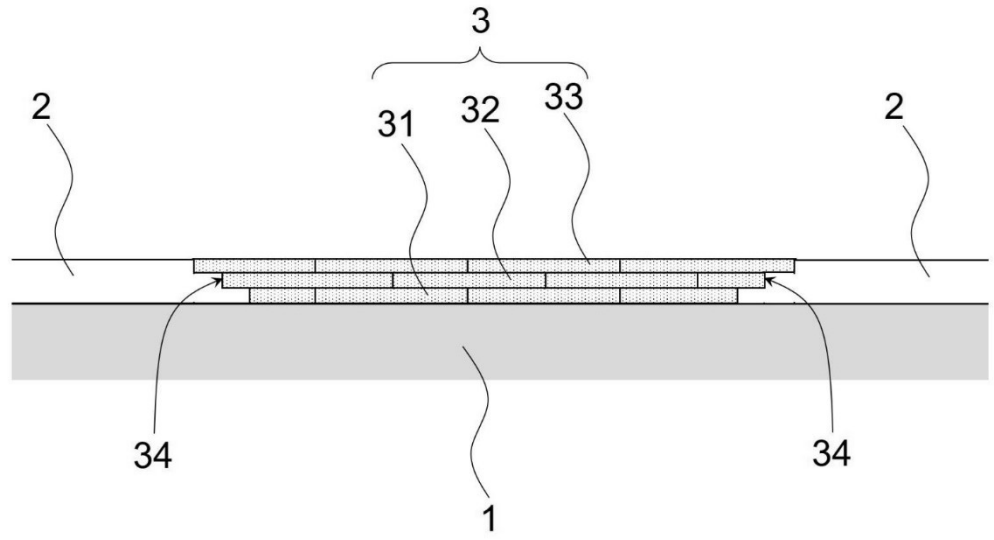

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