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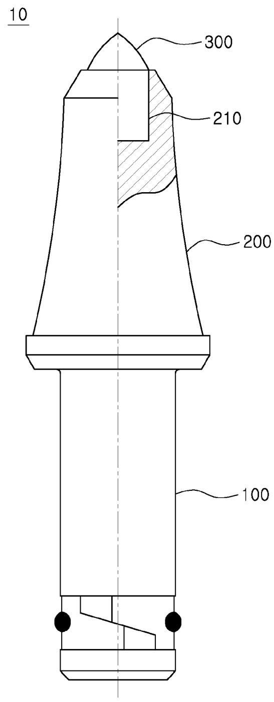
(54) METHOD FOR MANUFACTURING PICK CUTTER FOR EXCAVATION AND PICK CUTTER MANUFACTURED BY THIS METHOD

(57) The present disclosure relates to a method for manufacturing a pick cutter for excavation, including: a step of preparing a pick cutter having a joining groove and a super-hard insert inserted and joined into the joining groove; and a step of forming a surface reinforcement layer by plasma spray coating an alloy composition on the pick cutter, in which the surface reinforcement layer is formed from an end portion of the pick cutter to at least a part of the surface of the super-hard insert, and thus, it is possible to minimize wear and fall-off of the super-hard insert inserted into the end portion of the pick cutter for excavation, and significantly improve the life of the pick cutter.

FIG. 1



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Description

Field

[0001] The present disclosure relates to a method for manufacturing a pick cutter for excavation and a pick cutter manufactured by the same, and more particularly, to a method for manufacturing a pick cutter for excavation and a pick cutter manufactured by the same capable of minimizing wear and fall-off of a super-hard insert inserted into an end portion of a pick cutter for excavation.

Background

[0002] Typically, excavation equipment for excavation operation such as rock cutting has a number of pick cutters inserted into a surface of a rotating drum, and the pick cutters actually cut the rock as the drum rotates. Representative examples of such excavation equipment include roadheaders and continuous miners, which are structurally similar to roadheaders. Roadheaders are widely used in tunnels and mines around the world, and in the western world in particular, roadheaders are mainly used in tunnel excavation sites in urban areas.

[0003] The pick cutter, which is a part that actually performs cutting in the excavation equipment, is formed with a structure in which a super-hard alloy is inserted and fixed at a tip thereof. The super-hard alloy provided at the tip of the pick cutter is formed with a material that has excellent hardness and durability, so that it is not easily damaged even by repeated friction due to the cutting process. However, a body of the pick cutter with the super-hard alloy inserted has relatively low durability and hardness, making it difficult to strongly support the super-hard alloy. Accordingly, frequent wear and damage to the super-hard alloy and the body of the pick cutter cause problems such as shortened pick cutter replacement cycle, decreased productivity and efficiency, and increased costs.

[0004] Accordingly, research and development of technologies that may improve process efficiency by enhancing the support capacity of the pick cutter of the super-hard alloy are necessary.

Prior Art Document

Patent Document

[0005] (Patent Document 1) (Korea Utility Model Document 1) Registered Utility Model No. 20-0484982 (Registered on November 8, 2017)

Summary

[0006] The present disclosure provides a method for manufacturing a pick cutter for excavation and a pick cutter manufactured by the same capable of minimizing wear and fall-off of a super-hard insert inserted into an end portion of a pick cutter for excavation.

[0007] One embodiment of the present disclosure to achieve the above-described purpose relates to a method for manufacturing a pick cutter for excavation, including: a step of preparing a pick cutter (10) having a joining groove (210) at an end portion and a super-hard insert (300) inserted and joined into the joining groove (210); and a step of forming a surface reinforcement layer (400) by plasma spray coating an alloy composition on the pick cutter (10), in which the surface reinforcement layer (400) is formed from the end portion of the pick cutter (10) to at least a part of the surface of the super-hard insert (300).

[0008] The pick cutter (10) may include a body unit (100) joined to an excavation equipment; a head unit (200) which is extended from the body unit (100) to be formed, and in which the joining groove (210) is formed at an end portion; and a super-hard insert (300) inserted and joined into the joining groove (210).

[0009] The alloy composition may include at least one of iron (Fe), nickel (Ni), chromium (Cr), molybdenum (Mo), silicon (Si), carbon (C), cobalt (Co), titanium (Ti), and tungsten carbide (WC).

[0010] The alloy composition may include at least one of stainless steel, a tungsten carbide-cobalt alloy, a chromium carbide alloy, a chromium-nickel alloy, and a titanium carbide alloy.

[0011] A spraying angle during the plasma spray coating may be 80 to 100 degrees with respect to the surface of the pick cutter, a spray temperature during the plasma spray coating may be 1,400 to 1,700°C, and a spraying speed during the plasma spray coating may be 300 to 1,000 m/s.

[0012] The surface reinforcement layer (400) may be formed to completely cover the surface of the super-hard insert (300) exposed to the outside.

[0013] Another embodiment of the present disclosure relates to a pick cutter for excavation manufactured by the manufacturing method.

[0014] Another embodiment of the present disclosure relates to drum for excavation provided with the pick cutter (10).

[0015] According to the method for manufacturing an excavation pick cutter for excavation of the present disclosure, it is possible to minimize wear and fall-off of the super-hard insert inserted into the end portion of the pick cutter for excavation. Therefore, it is possible to significantly improve the life of the pick cutter.

Brief Description of Drawings

[0016]

FIG. 1 is a view illustrating a structure of a pick cutter;

FIGS. 2A and 2B are views illustrating a structure of a pick cutter in which a surface reinforcement layer is formed; and

FIG. 3 is shapes of pick cutter specimens used in Experimental Example 2.

Detailed Description

[0017] Before describing in detail the preferred embodiments of the present disclosure below, it should be noted that terms or words used in this specification and claims should not be interpreted as limited to their usual or dictionary meanings, but should be interpreted as meanings and concepts consistent with the technical spirit of the present disclosure.

[0018] Throughout this specification, whenever a part is said to "include" a component, this does not exclude other components, but rather includes other components, unless otherwise specifically stated.

[0019] Throughout this specification, "%" used to indicate the concentration of a particular substance means (weight/-weight)% for solid/solid, (weight/volume)% for solid/liquid, and (volume/volume)% for liquid/liquid, unless otherwise stated.

[0020] The identification codes in each step are used for convenience of explanation and do not describe the order of each step. Each step may be performed in a different order than stated unless the context clearly indicates a specific order. That is, each step may be performed in the same order as stated, may be performed substantially simultaneously, or may be performed in the opposite order.

[0021] The present disclosure will be described in detail with reference to the embodiments and drawings of the present disclosure. It will be apparent to those skilled in the art that these embodiments are presented only as examples to more specifically explain the present disclosure, and that the scope of the present disclosure is not limited by these embodiments.

[0022] Hereinafter, examples of the present disclosure will be described. However, the scope of the present disclosure is not limited to the preferred examples below, and those skilled in the art may implement various modified forms of the contents described in this specification within the scope of the present disclosure.

[0023] The present disclosure relates to a method for manufacturing of a pick cutter used in excavation equipment and a pick cutter for excavation equipment manufactured by the same, and more specifically, to a method for reinforcing a pick cutter to minimize wear and fall-off of a super-hard insert provided at a tip of the pick cutter.

[0024] One embodiment of the present disclosure relates to a method for manufacturing a pick cutter used in excavation equipment, specifically, the method includes a step of preparing a pick cutter which has a joining groove and in which a super-hard insert is inserted and joined into the joining groove; and a step of forming a surface reinforcement layer by plasma spray coating an alloy composition on the pick cutter. At this time, the surface reinforcement layer may be formed from an end portion of the pick cutter to at least a part of the surface of the super-hard insert.

[0025] First, the step of preparing the pick cutter on which the surface reinforcement layer is formed is performed. The pick cutter 10 has a structure in which a joining groove 210 is provided at the end portion and a super-hard insert 300 is inserted and joined into the joining groove 210, and its structure is simply illustrated in FIG. 1. The pick cutter 10 is a component that is joined to excavation equipment such as a road header or a continuous miner and directly comes into contact with rock to cut the rock. The pick cutter 10 includes a body unit 100 joined to the excavation equipment; a head unit 200 which is extended from the body unit 100 to be formed, and in which the joining groove 210 is formed at an end portion; and a super-hard insert 300 inserted and joined into the joining groove 210.

[0026] The body unit 100 is a basic skeleton of the pick cutter 10, is formed in a cylindrical shape, and is formed as a structure that supports the entire structure. The body unit 100 may be a cylindrical structure with a constant diameter overall, or a cylindrical structure with different diameters for each section. One end portion of the body unit 100 is provided with a head unit 200 that extends from the body unit 100, and a fastening structure is formed at the other end portion to join the pick cutter 10 to the excavation equipment. Such a fastening structure is a structure in which joining and fixing force are formed by the rotation of the pick cutter 10, and enables easy replacement of the pick cutter 10 which is a consumable.

[0027] The head unit 200 is formed by extending from one end portion of the body unit 100, and has a cone head shape with the largest diameter in a portion adjacent to the body unit 100, and the diameter of the area with the largest diameter in the head unit 200 may be formed to be larger than that of the body unit 100. The joining groove 210 is provided at the tip or end portion of the head unit 200, and the super-hard insert 300 may be inserted and joined therein.

[0028] The pick cutter 10 prepared in this manner may be prepared by undergoing a pretreatment operation to remove surface contaminants, rust, oil, or the like before the step of forming the surface reinforcement layer 400. For this purpose, grinding or machining operations may be performed as needed.

[0029] Next, a step of forming the surface reinforcement layer 400 is performed by plasma spray coating an alloy composition on the pick cutter 10.

[0030] The surface reinforcement layer 400 may be formed from the end portion of the head unit 200 that is the end portion of the pick cutter 10 to at least a part of the surface of the super-hard insert 300. That is, the surface reinforcement layer 400 may be formed from a part of the end surface of the head unit 200 that is exposed to the outside to at least a part of the surface of the super-hard insert 300, and the surface reinforcement layer 400 may be formed in a form that completely covers a ring-shaped boundary line formed when the super-hard insert 300 is joined to the head unit 200. In a case where the surface reinforcement layer 400 is formed to a part of the surface of the super-hard insert 300, the surface reinforcement layer 400 may be formed in a ring shape as illustrated in FIG. 2(A), and in a case where the surface reinforcement layer 400 is formed to completely cover the surface of the super-hard insert 300, the surface reinforcement layer 400 may be formed in a form capping the super-hard insert 300 as illustrated in FIG. 2(B). In this way, in a case where the surface reinforcement layer 400 is formed to completely cover the surface of the super-hard insert 300, the portion of the super-hard insert 300 where the rock is cut is completely reinforced by the surface reinforcement layer 400, so that damage and wear of the super-hard insert 300 may be effectively prevented during the excavation operation. In addition, even if a part of the surface reinforcement layer 400 is damaged as the excavation operation progresses, the excavation operation is still possible because the super-hard insert 300 still exists, so that the life of the pick cutter 10 may be significantly increased.

[0031] The alloy composition, which is a material for forming the surface reinforcement layer 400, may include at least one of iron (Fe), nickel (Ni), chromium (Cr), molybdenum (Mo), silicon (Si), carbon (C), cobalt (Co), titanium (Ti), and tungsten carbide (WC).

[0032] For example, the alloy composition may include at least one of stainless steel, tungsten carbide-cobalt alloy, chromium carbide alloy, chromium-nickel alloy, and titanium carbide alloy. Includes the chromium carbide alloy is used as the alloy composition, high hardness may be maintained at high temperatures, so that damage and wear due to friction at high temperatures when using the pick cutter 10 may be minimized, and in a case where the chromium-nickel alloy or the titanium carbide alloy is used, effects such as improved excavation performance through improved hardness and wear resistance and improved life of the pick cutter 10 may be expected.

[0033] It is preferable to use stainless steel containing iron, chromium, nickel, molybdenum, silicon and carbon, and specifically, it is preferable to use stainless steel containing 43 to 52 wt% of iron, 24 to 31 wt% of chromium, 11 to 19 wt% of nickel, 2 to 7 wt% of molybdenum, 1 to 5 wt% of silicon, and 0.5 to 3 wt% of carbon. In this case, in addition to the above-mentioned components, impurities that must be removed may be included in a total of less than 0.1 wt%. Stainless steel having such a composition has excellent strength, impact resistance, wear resistance and hardness, and thus, even when used as a reinforcing material for a rock cutting tool, damage or wear caused by impact or heat generated during cutting may be minimized.

[0034] Iron contained in the stainless steel may secure sufficient strength and impact resistance for rock cutting.

[0035] Chromium improves hardenability and thus wear resistance, and is preferably included in the alloy composition at 24 to 31 wt%. In a case where chromium is included below the range, the effect is insignificant, and in a case where chromium is included above the range, it causes a decrease in toughness and an increase in brittleness, and therefore it is preferably included within the weight range described above. More preferably, chromium may be included in the alloy composition at 26.5 to 30.2 wt%.

[0036] Nickel may be included in the alloy composition at 11 to 19 wt% to improve the stability of the crystal structure and internal strength, and is preferably included at 12.5 to 17. wt%.

[0037] Molybdenum may improve wear resistance by coarse-graining the crystal grains to improve both strength and hardness. Molybdenum may be included in the alloy composition at 2 to 7 wt%, and preferably at 2.6 to 5.8 wt%.

[0038] Silicon may improve fatigue strength, impact resistance, wear resistance, and hardness at high temperatures. Silicon is included in the alloy composition at 1 to 5 wt% to exhibit these effects, and if silicon exceeds the range, there is a problem of lowering toughness and increasing brittleness, so it is preferably included within the weight range described above, and more preferably, it may be included at 1.8 to 4.2 wt%.

[0039] Carbon may be included in the alloy composition at 0.5 to 3 wt%, and functions to improve hardness, wear resistance, and internal strength. If carbon is included in excess of the range, there is a problem of carbide layer precipitation and increased brittleness resulting therefrom, so it is preferably included within the weight range described above, and more preferably, it may be included at 0.7 to 1.5 wt%.

[0040] Plasma spray coating, which is a method for forming the surface reinforcement layer 400, is a coating method that is also called plasma spray coating, in which high-temperature plasma is generated, and when an alloy composition, which is a powder material for a layer, is added to it, the powder material is instantly melted, and the melted material is sprayed and adhered at high speed to form a layer.

[0041] In the present disclosure, there is an advantage in that a surface reinforcement layer 400 having a uniform thickness and shape may be formed overall by applying a plasma spray coating method instead of a general welding method for forming the surface reinforcement layer 400. In a case where a reinforcement layer is formed by welding to reinforce the joining portion of the super-hard insert 300 of the pick cutter 10, it is difficult to form a layer having a uniform thickness and shape overall, and the surface reinforcement layer 400 may not be uniformly attached to the pick cutter 10 due to the curved shape of the joining portion, which may result in defects. In addition, when using the excavation equipment, there is a high possibility that wear or damage will occur in a relatively thin area, and in order to prevent such problems, an additional process of uniformizing the surface thickness is required to form the surface reinforcement layer 400 having a uniform thickness, which reduces the productivity of the process.

[0042] On the other hand, in the case of reinforcing the joining portion of the super-hard insert 300 of the pick cutter 10 by using the plasma spray coating method, the surface reinforcing layer 400 having a uniform and constant thickness and properties may be formed overall, and since it may be attached closely to the joining portion having a curved shape, there is an advantage in that the surface reinforcing performance may be fully expressed.

[0043] In order to plasma spray coat the alloy composition onto the pick cutter 10, the spray angle during spray coating is preferably 80 to 100 degrees with respect to the surface of the pick cutter 10, because when the spray angle is within such an angle range, a coating layer having a constant thickness may be formed with uniform quality. In addition, the spray temperature may be 1,400 to 1,700°C, because when the spray temperature is within such a temperature range, the alloy composition may be effectively melted, and when the spray temperature is below the range, the alloy composition is not sufficiently melted, thereby making the plasma spray coating operation difficult, and even when the spray temperature exceeds the range, no additional increase in melting efficiency occurs, so it is rather inefficient in terms of energy consumption.

[0044] In addition, the spray speed may be 300 to 1,000 m/s, and preferably 450 to 800 m/s. When the spray speed is within the range, a coating layer of an appropriate thickness is formed, and since the crystallization of the sprayed molten alloy composition is uniformly performed, when the area close to the sprayed body is defined as the inner side and the area far from the sprayed body is defined as the outer side, a coating layer having uniform properties may be formed from the inner side to the outer side of the coating layer. When the spray speed is less than the range, the time consumed in the step of forming the overall surface reinforcement layer 400 is increased, which reduces workability, and problems such as reduced adhesion due to a decrease in temperature during spraying may occur depending on the spray distance. On the other hand, when the spray speed exceeds the range, a difference in properties occurs between the inner and outer sides of the surface reinforcement layer 400, which is the coating layer, and accordingly, the overall durability of the surface reinforcement layer 400 may be reduced, and it is difficult to form the surface reinforcement layer 400 having an overall uniform thickness and surface shape. Therefore, the spray speed is preferably within the above-described range.

[0045] The moving speed of a plasma gun or the pick cutter 10 for coating during plasma spraying may be 4 to 7 mm/s, and if the moving speed is less than the range, the surface reinforcement layer 400 is not formed with multiple thin coating layers being overlapped, but rather by thick coating layers being overlapped, so that the coating thickness control and the uniformity of the surface shape are poor, and the adhesion characteristics of the surface reinforcement layer 400 to the surface of the pick cutter 10 may be deteriorated.

[0046] Additionally, the distance between the plasma gun and the pick cutter 10 during plasma spraying may be 10 to 200 mm, and the coating density may be 90 to 95%.

[0047] After the step of forming the surface reinforcement layer 400 as described above, at least one additional process may be performed among a grinding step of forming the sprayed alloy composition to a more uniform thickness and increasing adhesion, a polishing step of removing surface roughness to reduce friction, and a cleaning step of removing contaminants or impurities generated during the manufacturing operation.

[0048] Through this process, reinforcement is provided in the area where the head unit 200 of the pick cutter 10 and the super-hard insert 300 are joined, so that there is an advantage in that when excavating, the durability and life of the pick cutter 10 itself are increased, and damage or fall-off of the super-hard insert 300 may be prevented.

[0049] Another embodiment of the present disclosure relates to an excavation pick cutter 10, and more specifically, to an excavation pick cutter 10 in which reinforcement is performed to at least a part of a super-hard insert 300 in a head unit 200 of the excavation pick cutter 10 by a plasma spray coating method, and such a pick cutter 10 may be manufactured by a method according to an embodiment of the present disclosure.

[0050] The excavation pick cutter 10 includes a body unit 100 joined to the excavation equipment; a head unit 200 which is extended from the body unit 100 to be formed, and in which the joining groove 210 is formed at an end portion; and a super-hard insert 300 inserted and joined into the joining groove 210.

[0051] The body unit 100 is a basic skeleton of the pick cutter 10, is formed in a cylindrical shape, and is formed as a structure that supports the entire structure. The body unit 100 may be a cylindrical structure with a constant diameter overall, or a cylindrical structure with different diameters for each section. One end portion of the body unit 100 is provided with a head unit 200 that extends from the body unit 100, and a fastening structure is formed at the other end portion to join the pick cutter 10 to the excavation equipment. Such a fastening structure is a structure in which joining and fixing force are formed by the rotation of the pick cutter 10, and enables easy replacement of the pick cutter 10 which is a consumable.

[0052] The head unit 200 is formed by extending from one end portion of the body unit 100, and has a cone head shape with the largest diameter in a portion adjacent to the body unit 100, and the diameter of the area with the largest diameter in the head unit 200 may be formed to be larger than that of the body unit 100. The joining groove 210 is provided at the tip or end portion of the head unit 200, and the super-hard insert 300 may be inserted and joined therein.

[0053] The method for reinforcing by the plasma spray coating method is described in the previous embodiment, so a duplicate description will be omitted, and in the end portion of the head unit 200 that is the end portion of the pick cutter 10 according to such a reinforcing method, the surface reinforcement layer 400 may be formed from the end portion of the head unit 200 to at least a part of the surface of the super-hard insert 300. Specifically, the surface reinforcement layer 400 may be formed from a part of the end surface of the head unit 200 that is exposed to the outside to at least a part of the surface of the super-hard insert 300, and the surface reinforcement layer 400 may be formed in a form that completely covers a ring-shaped boundary line formed when the super-hard insert 300 is joined to the head unit 200.

[0054] When the surface reinforcement layer 400 is formed to cover a part of the surface of the super-hard insert 300, the surface reinforcement layer 400 may be formed in a ring shape as illustrated in FIG. 2(A), and when the surface reinforcement layer 400 is formed to completely cover the surface of the super-hard insert 300, it may be formed in a shape that caps the super-hard insert 300 as illustrated in FIG. 2(B).

[0055] composition constituting the surface reinforcement layer 400 and the plasma spray coating method for forming the surface reinforcement layer 400 have been described in the previous embodiment of the present disclosure, so they are omitted.

[0056] The excavation pick cutter 10 having such a surface reinforcement layer 400 may minimize wear and fall-off of the super-hard insert 300 inserted into the end portion of the pick cutter 10, and thus has an advantage of significantly improving the life of the pick cutter 10.

[0057] Hereinafter, the specific operation and effect of the present disclosure will be explained through an embodiment of the present disclosure. However, this is presented as a preferred example of the present disclosure, and the scope of the rights of the present disclosure is not limited according to the example.

Experimental Example 1

[0058] First, an alloy composition having the composition of Table 1 was prepared and supplied to a plasma gun to form a coating layer with a thickness of 100 μm on a substrate. At this time, the distance between the substrate and the plasma gun was 25 mm, the spray angle was 90°, the coating density was $93\pm0.5\%$, the spray temperature was 1 ,500°C, and the spray speed was 620 m/s. The movement speed of the plasma gun was set to 5 mm/s and the plasma coating operation was performed.

Table 1

	Fe	Cr	Ni	Mo	Si	C	Total
Specimen 1	52.42	22.20	16.63	4.72	2.88	1.15	100
Specimen 2	50.25	26.51	15.33	4.07	2.65	1.19	100
Specimen 3	50.22	30.18	12.55	3.62	2.33	1.10	100
Specimen 4	48.55	32.64	12.88	3.15	1.86	0.92	100
Specimen 5	51.49	28.95	9.86	5.51	3.02	1.17	100
Specimen 6	44.79	25.81	22.65	3.92	1.88	0.95	100

[0059] Next, the impact resistance, wear resistance, tensile strength, and hardness of each manufactured stainless steel specimen were measured, and the results are illustrated in Table 2. The impact resistance was measured by the Charpy impact test method according to ISO 148-1, the wear resistance was measured by the ASTM G65, the tensile strength was measured by the ASTM E8, and hardness was measured by the Rockwell hardness test method according to the ASTM E18.

Table 2

	Impact resistance (J)	Wear resistance (mm^3/1,000 times)	Tensile strength (MPa)	Hardness (HRC)
Specimen 1	18.9	16.2	879.0	65.8
Specimen 2	21.5	22.4	865.7	66.2
Specimen 3	21.2	23.8	854.5	64.9
Specimen 4	16.5	22.7	755.1	65.0
Specimen 5	18.2	19.5	821.1	65.2
Specimen 6	18.0	20.1	812.4	64.5

[0060] Referring to the experimental results in Table 2, while Specimens 2 and 3 showed excellent characteristics in all items, Specimen 1 showed lower impact resistance and wear resistance compared to the other specimens. This is believed to be the result of an insufficient content of chromium, which affects the wear resistance. In addition, Specimen 4 showed excellent wear resistance but low impact resistance and tensile strength. This is believed to be the result of brittleness and reduced tensile strength caused by excessive chromium. In addition, Specimens 5 and 6 showed lower impact resistance, wear resistance, and tensile strength than Specimens 2 and 3. This is believed to be due to an insufficient or excessive content of nickel.

[0061] Therefore, as a result of this experiment, it was confirmed that in stainless steel containing iron, chromium, nickel, molybdenum, silicon, and carbon for application as the surface reinforcement layer of the pick cutter, the content of chromium and nickel is increased to improve properties such as the wear resistance and the impact resistance, and that the content of chromium is included in an amount of 24 to 31 wt%, preferably 26.5 to 30.2 wt%, of the total alloy composition, and that nickel is included in an amount of 11 to 19 wt%, preferably 12.5 wt% or more.

Experimental Example 2

[0062] First, three pick cutters were prepared, and a pick cutter without any separate surface reinforcement treatment was designated as Specimen 7. A surface reinforcement layer having the composition of Specimen 2 was formed on another pick cutter, designated as Specimen 8a, and an alloy material having the composition of Specimen 2 was prepared on the last pick cutter (Specimen 8b) and welded using a TIG (Tungsten Inert Gas) method to form the surface reinforcement layer having a thickness of about 100 μm.

[0063] As illustrated in FIG. 3, it may be confirmed that the surface reinforcement layer of specimen 8a has a smooth surface shape, and in particular, the corners of the surface reinforcement layer are formed in a shape close to a straight line. On the other hand, it may be confirmed that the surface reinforcement layer of specimen 8b has a non- smooth surface shape and the corners are formed in a curved shape. Since the higher the uniformity and smoothness of the surface reinforcement layer, the less friction it will have during excavation operation, which will lower the wear of the pick cutter and extend its lifespan, it may be confirmed that it is preferable to form the surface reinforcement layer by plasma coating rather than by welding.

Experimental Example 3

[0064] The plasma surface reinforcement layer was formed on the substrate in the same manner as in Experimental Example 1, and the spray speed of the plasma gun was adjusted in various ways as illustrated in Table 3. The results of measuring the properties of the surface reinforcement layer formed are illustrated in Table 3 for Specimens 9 to 13. In Table 3, Specimen 11 is the same specimen as Specimen 2.

Table 3

	Spray speed (m/s)	Impact resistance (J)	Wear resistance (mm^3/1,000 times)	Tensile strength (MPa)	Hardness (HRC)
Specimen 9	270	19.4	20.5	824.4	62.5
Specimen 10	450	21.1	21.8	859.0	65.1
Specimen 11	620	21.5	22.4	865.7	66.2
Specimen 12	800	22.1	22.5	867.4	66.0

(continued)

	Spray speed (m/s)	Impact resistance (J)	Wear resistance (mm^3/1,000 times)	Tensile strength (MPa)	Hardness (HRC)
Specimen 13	1050	19.9	20.7	845.2	63.4

[0065] Referring to the experimental results in Table 3, Specimens 10, 11, and 12 were found to have similar impact resistance, wear resistance, tensile strength, and hardness overall, but Specimens 9 and 13 were found to have relatively deteriorated properties in all items. Therefore, it was confirmed that the properties of the surface reinforcement layer formed by the plasma spray coating method differed depending on the spray speed of the plasma gun, and the properties deteriorated when the spray speed was too low or too high.

[0066] Therefore, as a result of this experiment, it was confirmed that the surface reinforcement layer with excellent properties may be formed when the spray speed during plasma spray coating is 300 to 1,000 m/s, and in particular, it is more preferable when the spray speed is controlled to 450 to 800 m/s.

[0067] The present disclosure is not limited to the specific embodiments and descriptions described above, and anyone with ordinary skill in the art to which the present disclosure pertains may make various modifications without departing from the gist of the present disclosure as claimed in the claims, and such modifications fall within the protection scope of the present disclosure.

Reference Signs List

[0068]

10: Pick cutter, 100: body unit
200: head unit, 210: joining groove
300: super-hard insert, 400: surface reinforcement layer

Claims

1. A method for manufacturing a pick cutter for excavation, comprising:

   a step of preparing a pick cutter (10) having a joining groove (210) at an end portion and a super-hard insert (300) inserted and joined into the joining groove (210); and
   a step of forming a surface reinforcement layer (400) by plasma spray coating an alloy composition on the pick cutter (10),
   wherein the surface reinforcement layer (400) is formed from the end portion of the pick cutter (10) to at least a part of the surface of the super-hard insert (300).

2. The method for manufacturing a pick cutter for excavation according to claim 1, wherein the pick cutter (10) includes:

   a body unit (100) joined to an excavation equipment;
   a head unit (200) which is extended from the body unit (100) to be formed, and in which the joining groove (210) is formed at the end portion; and
   a super-hard insert (300) inserted and joined into the joining groove (210).

3. The method for manufacturing a pick cutter for excavation according to claim 1, wherein
   the alloy composition includes at least one of iron (Fe), nickel (Ni), chromium (Cr), molybdenum (Mo), silicon (Si), carbon (C), cobalt (Co), titanium (Ti), and tungsten carbide (WC).

4. The method for manufacturing a pick cutter for excavation according to claim 1, wherein
   the alloy composition includes at least one of stainless steel, a tungsten carbide-cobalt alloy, a chromium carbide alloy, a chromium-nickel alloy, and a titanium carbide alloy.

5. The method for manufacturing a pick cutter for excavation according to claim 1, wherein
   a spraying angle during the plasma spray coating is 80 to 100 degrees with respect to the surface of the pick cutter.

6. The method for manufacturing a pick cutter for excavation according to claim 1, wherein a spray temperature during the plasma spray coating is 1,400 to 1,700°C.

7. The method for manufacturing a pick cutter for excavation according to claim 1, wherein a spraying speed during the plasma spray coating is 300 to 1,000 m/s.

8. The method for manufacturing a pick cutter for excavation according to claim 1, wherein the surface reinforcement layer (400) is formed to completely cover the surface of the super-hard insert (300) exposed to the outside.

9. A pick cutter for excavation manufactured by the manufacturing method according to claim 1.

10. A drum for excavation provided with a plurality of pick cutters (10) according to claim 9.

FIG. 1

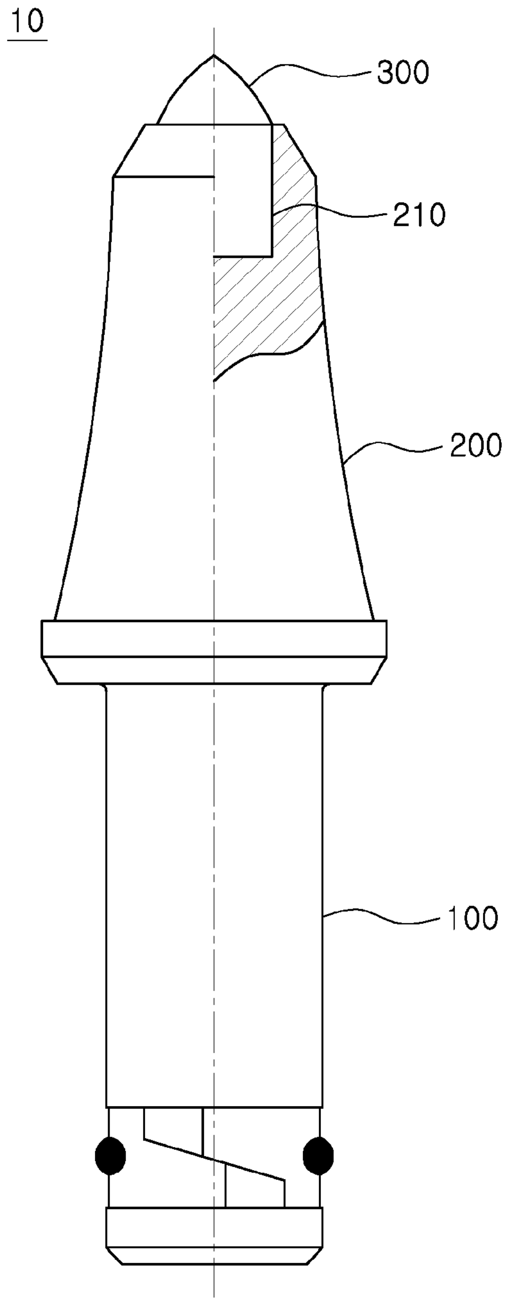

FIG. 2

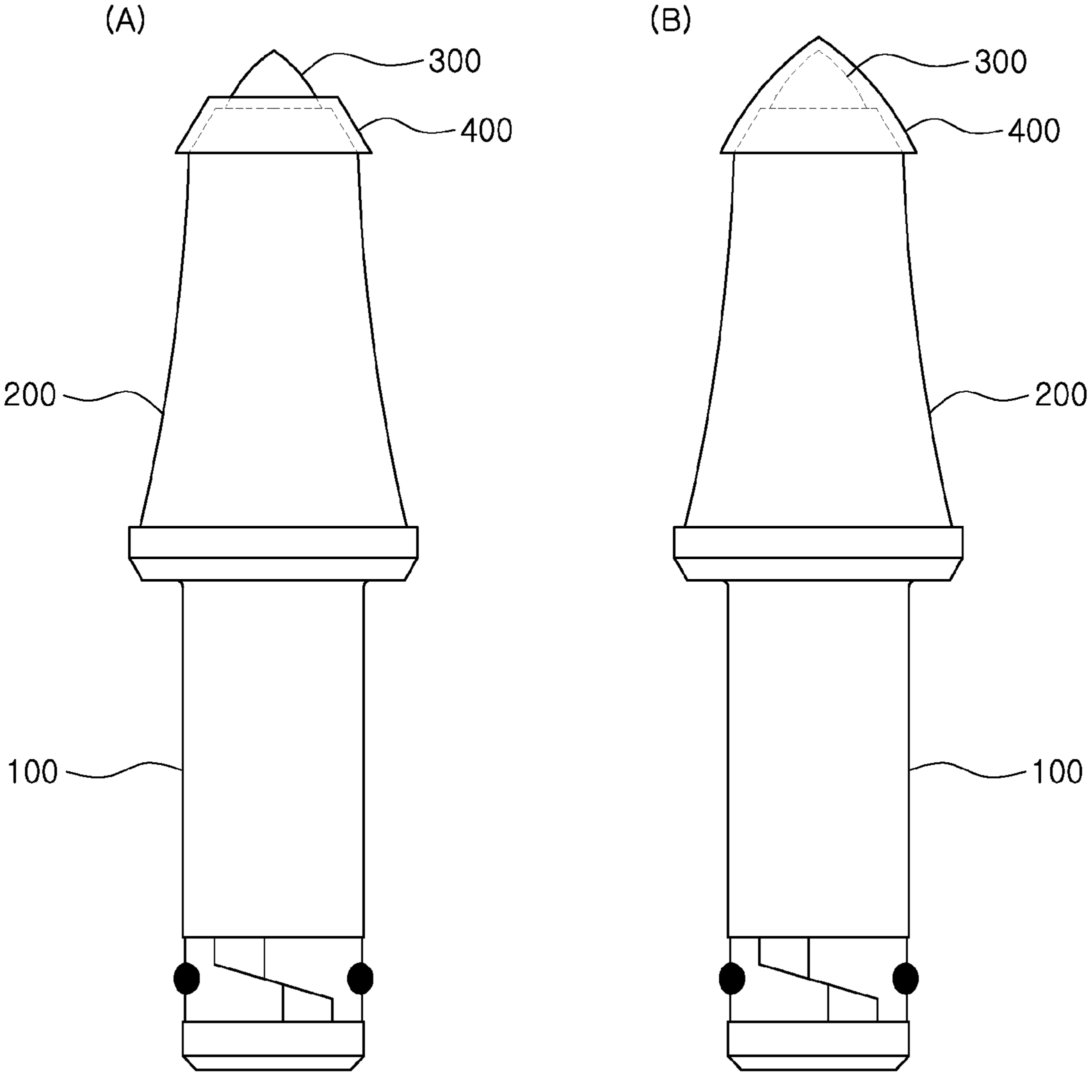

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 24 20 9823

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C23C
E21C

The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	17 November 2024	Chalaftris, Georgios

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