

SPECTACLE PLATE FOR CONCRETE PUMP TRUCK, PREPARATION METHOD THEREOF AND CONCRETE PUMP TRUCK

Cross-Reference to Related Applications

[001] The present disclosure is based on and claims the priority of Chinese patent application No. 202111325943.8 filed on November 10, 2021, the disclosure of which is incorporated herein by reference in its entirety.

Technical Field

[002] The present disclosure relates to the field of engineering machinery, in particular to a spectacle plate for a concrete pump truck, a preparation method thereof and a concrete pump truck.

Background

[003] A spectacle plate is a wearing part of a concrete pump truck. During pumping, the spectacle plate and a cutting ring move alternately and reciprocally to make a relative cutting motion to realize material suction and feeding. The spectacle plate not only needs to have good wear resistance, but also needs to have certain impact resistance and fatigue resistance.

[004] In some related arts, the spectacle plate is prepared by inlaying a cemented carbide in a crude steel substrate. The spectacle plate may be of a single alloy + inner hole surfacing structure, a dual alloy + inner hole surfacing structure, an all alloy structure or the like, which allows a cut surface and a material passing surface of the spectacle plate to be wear-resistant while ensuring overall impact resistance, so as to prolong the service life of parts.

[005] The cemented carbide and the crude steel substrate may be bonded by brazing. However, whether it is single alloy, dual alloy or all alloy, the crude steel substrate is bonded with the cemented carbide by copper brazing, and the spectacle plate prepared in this way has the following problems: (1) In long-term use, the wear resistance of the crude steel substrate and copper brazing gaps is poor, and a cemented carbide part is exposed after wear and is prone to cracking due to the impact wear of concrete stones, making the non-wear-resistant crude steel substrate in direct contact with concrete, which leads to slurry leakage during conveyance, and even serious wear and thus early failure of the spectacle plate such that a shutdown for part replacement is required,

which affects the construction progress. (2) From the perspective of production and processing, there are many production procedures to produce the spectacle plate with an alloy inlay structure, including: crude steel blanking, alloy grooving, alloy formwork preparation, brazing, surfacing, alloy surface grinding, drilling, inspection, paint spraying, etc. (3) The purchasing cost of the cemented carbide is high, which generally accounts for 60% to 80% of the price of the whole spectacle plate, resulting in a high cost of the parts of the entire spectacle plate.

Summary

[006] In one aspect of the present disclosure, a spectacle plate for a concrete pump truck is provided, including:

[007] a substrate which includes two through holes, a ridge part and two arc parts, the ridge part being arranged between the two through holes, and the two arc parts and the ridge part forming the two through holes;

[008] a first wear-resistant body which includes first parts and a second part, the two through holes being each provided with one first part, the first parts being connected to the ridge part, and the second part being arranged on a surface of the ridge part and located between the two through holes; and

[009] two second wear-resistant bodies, the two through holes being each provided with one second wear-resistant body, and the two second wear-resistant bodies being connected to the two arc parts respectively;

[010] wherein, a wear resistance of the first wear-resistant body is greater than that of the second wear-resistant body, and a wear resistance of the second wear-resistant body is greater than that of the substrate.

[011] In some embodiments, the second wear-resistant body includes a third part and a fourth part, the third part is arranged in the through hole, and the fourth part is connected to the third part and protrudes to the outside of the through hole.

[012] In some embodiments, the fourth part has a radial dimension larger than a radial dimension of the third part.

[013] In some embodiments, the first part and the second wear-resistant body in each of the two through holes form an entire inner wall of the through hole.

[014] In some embodiments, material composition of the first wear-resistant body includes at least two of zirconia, alumina and silicon carbide, and tungsten carbide; material composition of the second wear-resistant

body includes at least two of zirconia, alumina and silicon carbide; and material composition of the substrate includes cast steel.

[015] In another aspect of the present disclosure, a preparation method of a spectacle plate for a concrete pump truck is provided, including the following steps:

[016] mixing tungsten carbide powder, iron powder and at least two of zirconia powder, alumina powder and silicon carbide powder to prepare a first wear-resistant body;

[017] mixing at least two of zirconia powder, alumina powder and silicon carbide powder with iron powder to prepare a second wear-resistant body; and

[018] placing the first wear-resistant body and the two second wear-resistant bodies in a mold, pouring cast steel molten metal to form a substrate, and combining the substrate with the first wear-resistant body and the two second wear-resistant bodies to form the spectacle plate.

[019] In some embodiments, particle sizes of the zirconia powder, the alumina powder and the silicon carbide powder range from 0.02 mm to 0.1 mm.

[020] In some embodiments, a particle size of the tungsten carbide powder ranges from 5 μ m to 10 μ m.

[021] In some embodiments, a mass ratio of the combination of at least two of the zirconia powder, the alumina powder and the silicon carbide to the iron powder ranges from 1:1 to 3:1.

[022] In some embodiments, the mass ratio of the tungsten carbide powder to the combination of at least two of the zirconia powder, the alumina powder and the silicon carbide powder is less than 20%.

[023] In some embodiments, the tungsten carbide powder, the iron powder and at least two of the zirconia powder, the alumina powder and the silicon carbide powder are mixed and placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for a first preset time period after completely molten iron is obtained; and then cooling is conducted to obtain the first wear-resistant body.

[024] In some embodiments, at least two of the zirconia powder, the alumina powder and the silicon carbide powder with the iron powder are mixed and placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for a second preset time period after completely molten iron is obtained; and then cooling is conducted to obtain the second wear-resistant body.

[025] In some embodiments, cast steel is heated to 1500°C-1550°C to form the cast steel molten metal, and the cast steel molten metal is poured into the mold at 1480°C-1520°C to form the substrate.

[026] In another aspect of the present disclosure, a concrete pump truck is provided, including the spectacle

plate for the concrete pump truck.

[027] Based on the above technical scheme, the present disclosure has at least the following beneficial effects:

[028] In some embodiments, because the surface of the ridge part of the spectacle plate and an inner wall of the through hole connected to the ridge part are working surfaces where the spectacle plate cooperates with a cutting ring, which are more prone to wear, the surface of the ridge part and part of the inner wall of the through hole connected to the ridge part are provided with the first wear-resistant body, and the other part of the inner wall of the through hole is provided with the second wear-resistant body, that is, wear-resistant bodies are added at the cut surfaces where the spectacle plate cooperates with the cutting ring, and at a material passing hole, thus improving the wear resistance of the spectacle plate. In addition, a preset amount of tungsten is added to the wear-resistant body at the ridge part to improve the wear resistance and impact resistance of the wear-resistant body.

Brief Description of the Drawings

[029] The drawings described here are used to provide a further understanding of the present disclosure and constitute a part of the present application. The illustrative embodiments of the present disclosure and the description thereof are used to explain the present disclosure and do not constitute an improper limitation to the present disclosure. In the accompanying drawings:

[030] Fig. 1 is a schematic diagram of a spectacle plate for a concrete pump truck according to some embodiments of the present disclosure; and

[031] Fig. 2 is a schematic sectional view of Fig. 1 taken along line A-A.

[032] It should be understood that the dimensions of various parts shown in the drawings are not drawn according to the actual proportional relationship. In addition, the same or similar reference numerals refer to the same or similar components.

Detailed Description of the Embodiments

[033] Various exemplary embodiments of the present disclosure will now be described in detail with reference to the accompanying drawings. The description of the exemplary embodiments is only illustrative, and in no way should it be taken as any limitation on the present disclosure, its application or uses. The present

disclosure can be implemented in many different forms and is not limited to the embodiments described herein. These embodiments are provided so that the present disclosure will be thorough and complete, and the scope of the present disclosure will be fully delivered to those skilled in the art. It should be noted that: unless otherwise specified, the relative arrangement of parts and steps, the composition of materials, numerical expressions and numerical values set forth in these embodiments should be interpreted as exemplary only, not as a limitation.

[034] Words like “first” and “second” used in the present disclosure do not indicate any order, quantity or importance, but are only used to distinguish different parts. Words like “comprise” and “include” mean that the elements before the word cover the elements listed after the word, and the possibility of covering other elements is not excluded. “Up”, “down”, “left” and “right” are only used to indicate the relative positional relationship. When the absolute position of a described object changes, the relative positional relationship may also change accordingly.

[035] In the present disclosure, when it is described that a specific device is located between a first device and a second device, there may or may not be an intervening device between the specific device and the first device or the second device. When it is described that a specific device is connected to other devices, the specific device may be directly connected to the other devices without intervening devices, or not directly connected to the other devices with intervening devices.

[036] All terms (including technical terms and scientific terms) used in the present disclosure have the same meanings as those understood by those of ordinary skill in the art to which the present disclosure belongs, unless otherwise specifically defined. It should also be understood that terms defined in, for example, a general dictionary should be interpreted as having meanings consistent with their meanings in the context of related arts, and should not be interpreted in an idealized or extremely formal sense unless explicitly so defined here.

[037] Technologies, methods and equipment known to ordinary people in related fields may not be discussed in detail, but in appropriate cases, they should be regarded as part of the specification.

[038] Spectacle plate, also called wear plate, is an important part of a concrete pump. Because of the glasses-like shape, it is called spectacle plate.

[039] On concrete pumping machinery such as concrete pumps and pump trucks, the spectacle plate and a cutting ring are important parts in a concrete pumping system. The cutting ring is connected to an S-shaped swing pipe. Driven by a swing cylinder, the S-shaped swing pipe and the cutting ring swing from a concrete cylinder port on one side to a concrete cylinder port on the other side, while the spectacle plate is fixed on a

concrete hopper, and its two through holes respectively communicate with the concrete cylinder port on one side and the concrete cylinder port on the other side. In this way, when the swing cylinder drives the S-shaped swing pipe and the cutting ring to move, the spectacle plate and the cutting ring form a switching friction pair. Because of the rapid swing of the S-shaped swing pipe and the cutting ring, friction is generated between the spectacle plate and concrete, and the spectacle plate also bears an impact force of abrasive particles during switching. Therefore, the spectacle plate and the cutting ring bear the impact force, a shear force and a friction force at the same time during operation.

[040] For the spectacle plate, due to abrasive impact and cutting wear, a ridge part 32 of the spectacle plate is generally the first to wear and fail. In some related arts, although the ridge part 32 of the spectacle plate is reinforced with alloy, it is still a weak part of the spectacle plate.

[041] Based on this, some embodiments of the present disclosure provide a spectacle plate for a concrete pump truck, a preparation method thereof and a concrete pump truck, so as to solve the problem that spectacle plates are prone to wear.

[042] As shown in Figs. 1 and 2, some embodiments provide a spectacle plate for a concrete pump truck, including a substrate 3, a first wear-resistant body 1 and two second wear-resistant bodies 2.

[043] The substrate 3 includes two through holes 31, a ridge part 32 and two arc parts 33. The ridge part 32 is arranged between the two through holes 31, and the two arc parts 33 and the ridge part 32 form the two through holes 31.

[044] The first wear-resistant body 1 includes first parts 11 and a second part 12, the two through holes 31 are each provided with one first part 11, the first parts 11 are connected to the ridge part 32, and the second part 12 is arranged on a surface of the ridge part 32 and located between the two through holes 31.

[045] The two through holes 31 are each provided with one second wear-resistant body 2, and the two second wear-resistant bodies 2 are connected to the two arc parts 33 respectively.

[046] Wherein, a wear resistance of the first wear-resistant body 1 is greater than that of the second wear-resistant body 2, and a wear resistance of the second wear-resistant body 2 is greater than that of the substrate 3.

[047] In the above embodiments, a wearing part where the spectacle plate cooperates with the cutting ring is designed as a split structure, namely, the ridge part 32 and the two arc parts 33. The surface of the ridge part 32 and an inner wall of the through hole 31 connected to the ridge part 32 are working surfaces where the

spectacle plate cooperates with the cutting ring. The working surfaces include a cut surface and an inner wall surface of a material passing hole. The surface of the ridge part 32 is the cut surface, and an inner wall surface of the through hole 31 is the inner wall surface of the material passing hole. The cut surface and the material passing hole are more prone to wear. Therefore, the surface of the ridge part 32 and part of the inner wall of the through hole 31 connected to the ridge part 32 are provided with the first wear-resistant body 1, and inner sides of the two arc parts 32, that is, the other part of the inner wall of the through hole 31 is provided with the second wear-resistant body 2. The wear resistance of that first wear-resistant body 1 is great than that of the second wear-resistant body 2, and the wear resistance of the second wear-resistant body 2 is greater than that of the substrate 3, so that the wear resistance of the ridge part 32 of the spectacle plate can be improved, and the service life of the spectacle plate can be prolonged.

[048] As shown in Fig. 2, in some embodiments, the second wear-resistant body 2 includes a third part 21 and a fourth part 22, the third part 21 is arranged in the through hole 31, and the fourth part 22 is connected to the third part 21 and protrudes to the outside of the through hole 31.

[049] The two second wear-resistant bodies 2 cover connecting parts between the two through holes 31 and the arc parts 33, and the fourth parts 22 are connected to the third parts 21 and protrude to the outside of the through holes 31, that is, to the direction of the cutting ring, so as to better protect the substrate 3 of the spectacle plate from abrasion.

[050] In some embodiments, the fourth part 22 has a radial dimension larger than a radial dimension of the third part 21.

[051] The fourth part 22 covers part of a surface of the arc part 33 to improve the wear resistance of the arc part 33.

[052] In some embodiments, the first part 11 and the second wear-resistant body 2 in each of the two through holes 31 form an entire inner wall of the through hole 31.

[053] For each through hole 31, the first part 11 of the first wear-resistant body 1 is arranged at a position close to the ridge part 32, and the second wear-resistant body 2 is arranged at a position away from the ridge part 32; and the first part 11 and the second wear-resistant body 2 form the entire inner wall of the through hole 31 to improve the wear resistance of the inner wall of the whole through hole 31, the first part 11 close to the ridge part 32 is the first wear-resistant body 1, and the wear resistance of the first wear-resistant body 1 is greater than that of the second wear-resistant body 2, so as to further improve the wear resistance of the ridge

part 32 of the spectacle plate.

[054] In some embodiments, material composition of the first wear-resistant body 1 includes at least two of zirconia, alumina and silicon carbide, and tungsten carbide; material composition of the second wear-resistant body 2 includes at least two of zirconia, alumina and silicon carbide; and material composition of the substrate 3 includes cast steel.

[055] Zirconia, alumina and silicon carbide are wear-resistant ceramic materials. At least two of zirconia powder, alumina powder and silicon carbide powder being made into the second wear-resistant body 2 means that the second wear-resistant body 2 is made of wear-resistant ceramic materials, thus having good wear resistance and impact resistance.

[056] At least two of zirconia powder, alumina powder and silicon carbide powder, and tungsten carbide powder are made into the first wear-resistant body 1, the addition of tungsten to the ceramic wear-resistant materials further improving the wear resistance and impact resistance of the first wear-resistant body 1.

[057] Some embodiments of the present disclosure further provide a preparation method of the above spectacle plate for the concrete pump truck, including the following steps:

[058] mixing tungsten carbide powder, iron powder and at least two of zirconia powder, alumina powder and silicon carbide powder to prepare the first wear-resistant body 1;

[059] mixing at least two of zirconia powder, alumina powder and silicon carbide powder with iron powder to prepare the second wear-resistant body 2; and

[060] placing the first wear-resistant body 1 and the two second wear-resistant bodies 2 in a mold, pouring cast steel molten metal to form the substrate 3, and combining the substrate 3 with the first wear-resistant body 1 and the two second wear-resistant bodies 2 to form the spectacle plate.

[061] The spectacle plate in the disclosed embodiment is molded by integral vacuum casting.

[062] The surface of the ridge part 32 and an inner wall of the through hole 31 connected to the ridge part 32 are working surfaces where the spectacle plate cooperates with the cutting ring. The surface of the ridge part 32 is a cut surface, and the through hole 31 is a material passing hole. The cut surface and the material passing hole are more prone to wear. Therefore, the surface of the ridge part 32 and part of the inner wall of the through hole 31 connected to the ridge part 32 are provided with the first wear-resistant body 1, and the other part of the inner wall of the through hole 31 is provided with the second wear-resistant body 2, that is, ceramic wear-resistant bodies are added at the cut surface where the spectacle plate cooperates with the cutting ring and

at the material passing hole. The ceramic wear-resistant bodies and the substrate are integrally cast and molded, so that firm bonding is realized, and the problem that alloy or wear-resistant layers fall off caused by brazing, bonding and other processes is solved. The spectacle plate is only subjected to normal wear and failure in use, and the problem of 20% early failure caused by alloy block falling off or bouncing off and other reasons is avoided.

[063] In order to solve the problem that the wear resistance of the ridge part 32 of the spectacle plate is poor, a certain amount of tungsten is added to the wear-resistant material of the ridge part 32 to further improve the wear resistance and impact resistance of the wear-resistant body.

[064] In the disclosed embodiment, the spectacle plate is molded by integral vacuum casting, which saves the processing procedures of crude steel blanking, surfacing, alloy grooving, alloy formwork preparation, brazing, alloy surface polishing and the like, and has the advantages of easy processing, high production efficiency and low comprehensive cost. Compared with a conventional cemented carbide inlay process, the efficiency can be increased by 1.5 times.

[065] The wear-resistant bodies of the spectacle plate are ceramic wear-resistant bodies, and the cost of the ceramic wear-resistant bodies only accounts for 40% of the price of the whole spectacle plate, which greatly reduces the overall cost and realizes high cost performance, thus allowing users to have more choices.

[066] In some embodiments, particle sizes of the zirconia powder, the alumina powder and the silicon carbide powder range from 0.02 mm to 0.1 mm.

[067] The ceramic wear-resistant bodies are located at major working parts of the spectacle plate. The ceramic wear-resistant bodies are molded by high-temperature casting. Because of the large powder (0.02-0.1 mm), if there are defects such as inclusions and air holes in the molding process, effective filling can be performed by high-temperature infiltration in a secondary substrate casting process, and then the working surface of the spectacle plate can meet the application requirements after subsequent grinding.

[068] In some embodiments, a particle size of the tungsten carbide powder ranges from 5 μ m to 10 μ m.

[069] In some embodiments, a mass ratio of the combination of at least two of the zirconia powder, the alumina powder and the silicon carbide to the iron powder ranges from 1:1 to 3:1.

[070] In some embodiments, the mass ratio of the tungsten carbide powder to the combination of at least two of the zirconia powder, the alumina powder and the silicon carbide powder is less than 20%.

[071] In some embodiments, tungsten carbide powder, iron powder and at least two of zirconia powder,

alumina powder and silicon carbide powder are mixed and placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for a first preset time period after completely molten iron is obtained; and then cooling is conducted to obtain the first wear-resistant body 1.

[072] In some embodiments, at least two of zirconia powder, alumina powder and silicon carbide powder and iron powder are mixed and placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for a second preset time period after completely molten iron is obtained; and then cooling is conducted to obtain the second wear-resistant body 2.

[073] In some embodiments, cast steel is heated to 1500°C-1550°C to form the cast steel molten metal, and the cast steel molten metal is poured into the mold at 1480°C-1520°C to form the substrate 3.

[074] In some embodiments, the preparation method of the spectacle plate for the concrete pump truck mainly includes the following steps:

[075] Step 1: Wear-resistant bodies are prefabricated. Two or more of zirconia powder, alumina powder and silicon carbide powder, which are all wear-resistant ceramic powder, are mixed, and the particle size of the wear-resistant ceramic powder is 0.02 mm -0.1 mm. Tungsten carbide powder (the particle size of the tungsten carbide powder is 5 μm-10μm) is added to the wear-resistant ceramic powder, and then mixed with iron powder. Here, the mass ratio of the wear-resistant ceramic powder to the iron powder is (1-3):1, and the mass ratio of the tungsten carbide powder to the wear-resistant ceramic powder is less than 20%. The mixed wear-resistant material is placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for 20 min after completely molten iron is obtained. Then cooling is conducted to obtain the first wear-resistant body 1.

[076] Two or more of zirconia powder, alumina powder and silicon carbide powder, which are all wear-resistant ceramic powder, are adopted, and the particle size of the powder is 0.02 mm -0.1 mm. The wear-resistant ceramic powder is mixed with iron powder, and the mass ratio of the wear-resistant ceramic powder to the iron powder is (1-3):1. The mixed wear-resistant material is placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for 20 min after completely molten iron is obtained. Then cooling is conducted to obtain the second wear-resistant body 2.

[077] Step 2: Cast-molding is conducted. Melting is conducted in an intermediate frequency furnace with a capacity of 1 ton, and cast steel molten metal is used as casting molten metal. The temperature is increased to 1500°C-1550°C. When completely molten metal is obtained, pouring is conducted at a pouring temperature of 1480°C-1520°C to form the substrate 3 of the spectacle plate, and the substrate 3 is metallurgically combined

with the first wear-resistant body 1 and the two second wear-resistant bodies 2 prepared in advance.

[078] Step 3: Sand shakeout and cooling are conducted. Sand shakeout and casting mold cleaning are conducted. Ceramic wear-resistant spectacle plate blank is obtained after natural cooling, and then machining is conducted as needed to obtain spectacle plate parts.

[079] For the spectacle plate in the above embodiment, the substrate 3 is formed by pouring the cast steel molten metal, the surface of the ridge part 32 and the parts where through holes 31 are adjacent to the ridge part 32 are provided with the first wear-resistant body 1, and the parts where the through holes 31 are adjacent to the arc parts 33 are provided with the two second wear-resistant bodies 2. For each through hole 31, the first part 11 of the first wear-resistant body 1 is arranged at a position close to the ridge part 32, the second wear-resistant body 2 is arranged at a position away from the ridge part 32, and the first part 11 and the second wear-resistant body 2 form the entire inner wall of the through hole 31. The second wear-resistant body 2 is a wear-resistant body obtained after wear-resistant ceramic powder is mixed with iron powder, and the first wear-resistant body 1 is a wear-resistant body arranged at the ridge part 32 containing tungsten carbide powder. The particle size of the tungsten carbide powder here is $5\mu\text{m}$ - $10\mu\text{m}$.

[080] In the embodiments of the present disclosure, a preset amount of tungsten carbide is added to the wear-resistant body located at the ridge part 32 of the spectacle plate, which enhances the wear resistance of the vulnerable ridge part 32 of the spectacle plate.

[081] The hardness of the ceramic wear-resistant bodies of the spectacle plate parts prepared according to the disclosed embodiment can be more than 88 HRA, the wear rate is less than 0.025%, the bending strength is more than 2400 MPa, and the impact toughness is more than 5 J/cm^2 .

[082] Embodiment 1

[083] Step 11: Wear-resistant bodies were prefabricated. Zirconia powder and alumina powder, which are both wear-resistant ceramic powder and both had a particle size of 0.02 mm, were mixed. Tungsten carbide powder (the particle size of the tungsten carbide powder was $5\mu\text{m}$) was added to the wear-resistant ceramic powder, and then mixed with iron powder. Here, the mass ratio of the wear-resistant ceramic powder to the iron powder was 3:1, and the mass ratio of the tungsten carbide powder to the wear-resistant ceramic powder was less than 20%. The mixed wear-resistant material was placed in a furnace and heated to 1350°C - 1480°C , and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the first wear-resistant body 1.

[084] Zirconia powder and alumina powder, which are both wear-resistant ceramic powder and both had a particle size of 0.02 mm, were used. The wear-resistant ceramic powder was mixed with iron powder, and the mass ratio of the wear-resistant ceramic powder to the iron powder was 3:1. The mixed wear-resistant material was placed in a furnace and heated to 1350°C -1480 °C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the second wear-resistant body 2.

[085] Step 12: Cast-molding was conducted. Melting was conducted in an intermediate frequency furnace with a capacity of 1 ton, and cast steel molten metal was used as casting molten metal. The temperature was increased to 1500°C -1550 °C. When completely molten metal was obtained, pouring was conducted at a pouring temperature of 1480 °C -1520 °C to form the substrate 3 of the spectacle plate, and the substrate 3 was metallurgically combined with the first wear-resistant body 1 and the two second wear-resistant bodies 2 prepared in advance.

[086] Step 13: Sand shakeout and cooling were conducted. Sand shakeout and casting mold cleaning were conducted. Ceramic wear-resistant spectacle plate blank was obtained after natural cooling, and then machining was conducted as needed to obtain spectacle plate parts.

[087] For the spectacle plate in Embodiment 1, the substrate 3 was formed by pouring the cast steel molten metal, the surface of the ridge part 32 and the parts where through holes 31 are adjacent to the ridge part 32 were provided with the first wear-resistant body 1, and the parts where the through holes 31 are adjacent to the arc parts 33 were provided with the two second wear-resistant bodies 2. For each through hole 31, the first part 11 of the first wear-resistant body 1 was arranged at a position close to the ridge part 32, the second wear-resistant body 2 was arranged at a position away from the ridge part 32, and the first part 11 and the second wear-resistant body 2 formed the entire inner wall of the through hole 31. The second wear-resistant body 2 was a wear-resistant body obtained after wear-resistant ceramic powder was mixed with iron powder, and the first wear-resistant body 1 was a wear-resistant body arranged at the ridge part 32 containing tungsten carbide powder. The particle size of the tungsten carbide powder here was 5μm.

[088] In Embodiment 1, a preset amount of tungsten carbide was added to the wear-resistant body located at the ridge part 32 of the spectacle plate, which enhanced the wear resistance of the vulnerable ridge part 32 of the spectacle plate.

[089] The hardness of the ceramic wear-resistant bodies of the spectacle plate parts prepared according to Embodiment 1 could reach 89 HRA, the wear rate was less than 0.024%, the bending strength was 3100 MPa,

and the impact toughness was more than 6.2 J/cm².

[090] Embodiment 2

[091] Step 21: Wear-resistant bodies were prefabricated. Zirconia powder, alumina powder and silicon carbide powder, which are all wear-resistant ceramic powder and all had a particle size of 0.1 mm, were used. Tungsten carbide powder (the particle size of the tungsten carbide powder was 10μm) was added to the wear-resistant ceramic powder, and then mixed with iron powder. Here, the mass ratio of the wear-resistant ceramic powder to the iron powder was 1:1, and the mass ratio of the tungsten carbide powder to the wear-resistant ceramic powder was less than 20%. The mixed wear-resistant material was placed in a furnace and heated to 1350°C-1480°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the first wear-resistant body 1.

[092] Zirconia powder, alumina powder and silicon carbide powder, which are all wear-resistant ceramic powder and all had a particle size of 0.1 mm, were used. The wear-resistant ceramic powder was mixed with iron powder, and the mass ratio of the wear-resistant ceramic powder to the iron powder was 1:1. The mixed wear-resistant material was placed in a furnace and heated to 1350°C-1480°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the second wear-resistant body 2.

[093] Step 22: Cast-molding was conducted. Melting was conducted in an intermediate frequency furnace with a capacity of 1 ton, and cast steel molten metal was used as casting molten metal. The temperature was increased to 1500°C-1550°C. When completely molten metal was obtained, pouring was conducted at a pouring temperature of 1480°C-1520°C to form the substrate 3 of the spectacle plate, and the substrate 3 was metallurgically combined with the first wear-resistant body 1 and the two second wear-resistant bodies 2 prepared in advance.

[094] Step 23: Sand shakeout and cooling were conducted. Sand shakeout and casting mold cleaning were conducted. Ceramic wear-resistant spectacle plate blank was obtained after natural cooling, and then machining was conducted as needed to obtain spectacle plate parts.

[095] For the spectacle plate in Embodiment 2, the substrate 3 was formed by pouring the cast steel molten metal, the surface of the ridge part 32 and the parts where through holes 31 are adjacent to the ridge part 32 were provided with the first wear-resistant body 1, and the parts where the through holes 31 are adjacent to the arc parts 33 were provided with the two second wear-resistant bodies 1. For each through hole 31, the first part

11 of the first wear-resistant body 1 was arranged at a position close to the ridge part 32, the second wear-resistant body 2 was arranged at a position away from the ridge part 32, and the first part 11 and the second wear-resistant body 2 formed the entire inner wall of the through hole 31. The second wear-resistant body 2 was a wear-resistant body obtained after wear-resistant ceramic powder was mixed with iron powder, and the first wear-resistant body 1 was a wear-resistant body arranged at the ridge part 32 containing tungsten carbide powder. The particle size of the tungsten carbide powder here was 10 μ m.

[096] In Embodiment 2, a preset amount of tungsten carbide was added to the wear-resistant body located at the ridge part 32 of the spectacle plate, which enhanced the wear resistance and impact resistance of the vulnerable ridge part 32 of the spectacle plate.

[097] The hardness of the ceramic wear-resistant bodies of the spectacle plate parts prepared according to Embodiment 2 could reach 88 HRA, the wear rate was less than 0.020%, the bending strength was 2412 MPa, and the impact toughness was more than 5.2 J/cm².

[098] Embodiment 3

[099] Step 31: Wear-resistant bodies were prefabricated. Zirconia powder, alumina powder and silicon carbide powder, which are all wear-resistant ceramic powder and all had a particle size of 0.08mm, were used. Tungsten carbide powder (the particle size of the tungsten carbide powder was 7 μ m) was added to the wear-resistant ceramic powder, and then mixed with iron powder. Here, the mass ratio of the wear-resistant ceramic powder to the iron powder was 2:1, and the mass ratio of the tungsten carbide powder to the wear-resistant ceramic powder was less than 20%. The mixed wear-resistant material was placed in a furnace and heated to 1350°C-1480°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the first wear-resistant body 1.

[0100] Zirconia powder, alumina powder and silicon carbide powder, which are all wear-resistant ceramic powder and all had a particle size of 0.08mm, were used. The wear-resistant ceramic powder was mixed with iron powder, and the mass ratio of the wear-resistant ceramic powder to the iron powder was 2:1. The mixed wear-resistant material was placed in a furnace and heated to 1350°C-1480°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the second wear-resistant body 2.

[0101] Step 32: Cast-molding was conducted. Melting was conducted in an intermediate frequency furnace with a capacity of 1 ton, and cast steel molten metal was used as casting molten metal. The temperature was

increased to 1500°C-1550°C. When completely molten metal was obtained, pouring was conducted at a pouring temperature of 1480°C-1520°C to form the substrate 3 of the spectacle plate, and the substrate 3 was metallurgically combined with the first wear-resistant body 1 and the two second wear-resistant bodies 2 prepared in advance.

[0102] Step 33: Sand shakeout and cooling were conducted. Sand shakeout and casting mold cleaning were conducted. Ceramic wear-resistant spectacle plate blank was obtained after natural cooling, and then machining was conducted as needed to obtain spectacle plate parts.

[0103] For the spectacle plate in Embodiment 3, the substrate 3 was formed by pouring the cast steel molten metal, the surface of the ridge part 32 and the parts where through holes 31 are adjacent to the ridge part 32 were provided with the first wear-resistant body 1, and the parts where the through holes 31 are adjacent to the arc parts 33 were provided with the two second wear-resistant bodies 2. For each through hole 31, the first part 11 of the first wear-resistant body 1 was arranged at a position close to the ridge part 32, the second wear-resistant body 2 was arranged at a position away from the ridge part 32, and the first part 11 and the second wear-resistant body 2 formed the entire inner wall of the through hole 31. The second wear-resistant body 2 was a wear-resistant body obtained after wear-resistant ceramic powder was mixed with iron powder, and the first wear-resistant body 1 was a wear-resistant body arranged at the ridge part 32 containing tungsten carbide powder. The particle size of the tungsten carbide powder here was 7 μ m.

[0104] In Embodiment 3, a preset amount of tungsten carbide was added to the wear-resistant body located at the ridge part 32 of the spectacle plate, which enhanced the wear resistance and impact resistance of the vulnerable ridge part 32 of the spectacle plate.

[0105] The hardness of the ceramic wear-resistant bodies of the spectacle plate parts prepared according to Embodiment 3 could reach 89 HRA, the wear rate was less than 0.023%, the bending strength was 2642 MPa, and the impact toughness was more than 5.1 J/cm².

[0106] Embodiment 4

[0107] Step 41: Wear-resistant bodies were prefabricated. Zirconia powder and alumina powder, which are both wear-resistant ceramic powder and both had a particle size of 0.02 mm, were mixed. Tungsten carbide powder (the particle size of the tungsten carbide powder was 5 μ m) was added to the wear-resistant ceramic powder, and then mixed with iron powder. Here, the mass ratio of the wear-resistant ceramic powder to the iron powder was 2:1, and the mass ratio of the tungsten carbide powder to the wear-resistant ceramic powder was

less than 20%. The mixed wear-resistant material was placed in a furnace and heated to 1350°C-1480°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the first wear-resistant body 1.

[0108] Zirconia powder and alumina powder, which are both wear-resistant ceramic powder and both had a particle size of 0.02 mm, were mixed. The wear-resistant ceramic powder was mixed with iron powder, and the mass ratio of the wear-resistant ceramic powder to the iron powder was 2:1. The mixed wear-resistant material was placed in a furnace and heated to 1350°C-1480°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the second wear-resistant body 2.

[0109] Step 42: Cast-molding was conducted. Melting was conducted in an intermediate frequency furnace with a capacity of 1 ton, and cast steel molten metal was used as casting molten metal. The temperature was increased to 1500°C-1550°C. When completely molten metal was obtained, pouring was conducted at a pouring temperature of 1480°C-1520°C to form the substrate 3 of the spectacle plate, and the substrate 3 was metallurgically combined with the first wear-resistant body 1 and the two second wear-resistant bodies 2 prepared in advance.

[0110] Step 43: Sand shakeout and cooling were conducted. Sand shakeout and casting mold cleaning were conducted. Ceramic wear-resistant spectacle plate blank was obtained after natural cooling, and then machining was conducted as needed to obtain spectacle plate parts.

[0111] For the spectacle plate in Embodiment 4, the substrate 3 was formed by pouring the cast steel molten metal, the surface of the ridge part 32 and the parts where through hole 31 are adjacent to the ridge part 32 were provided with the first wear-resistant body 1, and the parts where the through holes 31 are adjacent to the arc parts 33 were provided with the two second wear-resistant bodies 2. For each through hole 31, the first part 11 of the first wear-resistant body 1 was arranged at a position close to the ridge part 32, the second wear-resistant body 2 was arranged at a position away from the ridge part 32, and the first part 11 and the second wear-resistant body 2 formed the entire inner wall of the through hole 31. The second wear-resistant body 2 was a wear-resistant body obtained after wear-resistant ceramic powder was mixed with iron powder, and the first wear-resistant body 1 was a wear-resistant body arranged at the ridge part 32 containing tungsten carbide powder. The particle size of the tungsten carbide powder here was 5μm.

[0112] In Embodiment 4, a preset amount of tungsten carbide was added to the wear-resistant body located at the ridge part 32 of the spectacle plate, which enhanced the wear resistance of the vulnerable ridge part 32 of

the spectacle plate.

[0113] The hardness of the ceramic wear-resistant bodies of the spectacle plate parts prepared according to Embodiment 4 could reach 88 HRA, the wear rate was more than 0.087%, the bending strength was 3300 MPa, and the impact toughness was more than 9.0 J/cm².

[0114] Embodiment 5

[0115] Step 51: Wear-resistant bodies were prefabricated. Zirconia powder and alumina powder, which are both wear-resistant ceramic powder and both had a particle size of 0.08mm, were mixed. Tungsten carbide powder (the particle size of the tungsten carbide powder was 5 μ m) was added to the wear-resistant ceramic powder, and then mixed with iron powder. Here, the mass ratio of the wear-resistant ceramic powder to the iron powder was 3:1, and the mass ratio of the tungsten carbide powder to the wear-resistant ceramic powder was less than 20%. The mixed wear-resistant material was placed in a furnace and heated to 1300°C-1390°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the second wear-resistant body 2.

[0116] Zirconia powder and alumina powder, which are both wear-resistant ceramic powder and both had a particle size of 0.08mm, were mixed. The wear-resistant ceramic powder was mixed with iron powder, and the mass ratio of the wear-resistant ceramic powder to the iron powder was 3:1. The mixed wear-resistant material was placed in a furnace and heated to 1300°C-1390°C, and the temperature was maintained for 20 min after completely molten iron was obtained. Then cooling was conducted to obtain the second wear-resistant body 2.

[0117] Step 52: Cast-molding was conducted. Melting was conducted in an intermediate frequency furnace with a capacity of 1 ton, and cast steel molten metal was used as casting molten metal. The temperature was increased to 1500°C-1550°C. When completely molten metal was obtained, pouring was conducted at a pouring temperature of 1480°C-1520°C to form the substrate 3 of the spectacle plate, and the substrate 3 was metallurgically combined with the first wear-resistant body 1 and the two second wear-resistant bodies 2 prepared in advance.

[0118] Step 53: Sand shakeout and cooling were conducted. Sand shakeout and casting mold cleaning were conducted. Ceramic wear-resistant spectacle plate blank was obtained after natural cooling, and then machining was conducted as needed to obtain spectacle plate parts.

[0119] For the spectacle plate in Embodiment 5, the substrate 3 was formed by pouring the cast steel molten metal, the surface of the ridge part 32 and the parts where through hole 31 are adjacent to the ridge part 32 were

provided with the first wear-resistant body 1, and the parts where the through holes 31 are adjacent to the arc parts 33 were provided with the two second wear-resistant bodies 2. For each through hole 31, the first part 11 of the first wear-resistant body 1 was arranged at a position close to the ridge part 32, the second wear-resistant body 2 was arranged at a position away from the ridge part 32, and the first part 11 and the second wear-resistant body 2 formed the entire inner wall of the through hole 31. The second wear-resistant body 2 was a wear-resistant body obtained after wear-resistant ceramic powder was mixed with iron powder, and the first wear-resistant body 1 was a wear-resistant body arranged at the ridge part 32 containing tungsten carbide powder. The particle size of the tungsten carbide powder here was 5 μ m.

[0120] In Embodiment 5, a preset amount of tungsten carbide was added to the wear-resistant body located at the ridge part 32 of the spectacle plate, which enhanced the wear resistance of the vulnerable ridge part 32 of the spectacle plate.

[0121] The hardness of the ceramic wear-resistant bodies of the spectacle plate parts prepared according to Embodiment 5 could reach 81 HRA, the wear rate was more than 0.109%, the bending strength was 1630 MPa, and the impact toughness was less than 4.2 J/cm².

[0122] Based on the above-mentioned embodiments, the present disclosure has at least the following beneficial effects:

- (1) The spectacle plate has a simple structure and a simple production process, and is easy to process and low in cost.
- (2) The powder of the ceramic wear-resistant bodies of the spectacle plate is strictly screened and mixed, which solves the problems of powder shedding and peeling in wear-resistant layers caused by uneven mixing.
- (3) Tungsten carbide is added to the ridge part 32, the weak position of the spectacle plate, to increase the wear resistance.
- (4) The substrate of the spectacle plate and the ceramic wear-resistant bodies are metallurgically combined, and copper brazing and wear-resistant surfacing processes are omitted, so that there is no weak working part.
- (5) The substrate of the spectacle plate and the wear-resistant bodies are combined into a whole by high-temperature casting, which enhances the wear resistance of a working face of the spectacle plate.
- (6) Although the spectacle plate is integrally formed, the working face and non-working faces are made of different materials, which not only ensures the wear resistance of the working face, but also ensures the machinability, installation and fixation of the substrate.

[0123] Some embodiments of the present disclosure further provide a concrete pump truck, including the spectacle plate for the concrete pump truck.

[0124] The whole spectacle plate is molded by high-temperature casting and made of a carbon steel material. The wear-resistant bodies are combined with the substrate by high-temperature casting, and the working surface is composed of the ceramic wear-resistant bodies, thus ensuring the wear resistance of the spectacle plate in work. Further, the toughness and machinability of the substrate are also guaranteed.

[0125] Based on the above-mentioned embodiments of the present disclosure, the technical features of one embodiment can be beneficially combined with one or more other embodiments, unless explicitly negated.

[0126] Although some specific embodiments of the present disclosure have been described in detail by examples, those skilled in the art should understand that the above examples are for illustration only, and are not intended to limit the scope of the present disclosure. Those skilled in the art should understand that the above embodiments can be modified or some technical features can be equivalently replaced without departing from the scope and spirit of the present disclosure. The scope of the present disclosure is defined by the appended claims.

Claims

1. A spectacle plate for a concrete pump truck, comprising:

a substrate (3) which comprises two through holes (31), a ridge part (32) and two arc parts (33), the ridge part (32) being arranged between the two through holes (31), and the two arc parts (33) and the ridge part (32) forming the two through holes (31);

a first wear-resistant body (1) which comprises first parts (11) and a second part (12), the two through holes (31) being each provided with one first part (11), the first parts (11) being connected to the ridge part (32), and the second part (12) being arranged on a surface of the ridge part (32) and located between the two through holes (31); and

two second wear-resistant bodies (2), the two through holes (31) being each provided with one second wear-resistant body (2), and the two second wear-resistant bodies (2) being connected to the two arc parts (33) respectively;

wherein a wear resistance of the first wear-resistant body (1) is greater than that of the second wear-resistant body (2), and a wear resistance of the second wear-resistant body (2) is greater than that of the substrate (3).

2. The spectacle plate for a concrete pump truck of claim 1, wherein the second wear-resistant body (2) comprises a third part (21) and a fourth part (22), the third part (21) being arranged in the through hole (31), and the fourth part (22) being connected to the third part (21) and protruding to the outside of the through hole (31).

3. The spectacle plate for a concrete pump truck of claim 2, wherein the fourth part (22) has a radial dimension larger than a radial dimension of the third part (21).

4. The spectacle plate for a concrete pump truck of any one of claims 1-3, wherein the first part (11) and the second wear-resistant body (2) in each of the two through holes (31) form an entire inner wall of the through hole (31).

5. The spectacle plate for a concrete pump truck of any one of claims 1-4, wherein material composition of the first wear-resistant body (1) comprises at least two of zirconia, alumina and silicon carbide, and tungsten carbide; material composition of the second wear-resistant body (2) comprises at least two of zirconia, alumina and silicon carbide; and material composition of the substrate (3) comprises cast steel.

6. A preparation method of the spectacle plate for a concrete pump truck of any one of claims 1-5, comprising the following steps:

mixing tungsten carbide powder, iron powder with at least two of zirconia powder, alumina powder and silicon carbide powder to prepare the first wear-resistant body (1);

mixing at least two of zirconia powder, alumina powder and silicon carbide powder with iron powder to prepare the second wear-resistant body (2); and

placing the first wear-resistant body (1) and the two second wear-resistant bodies (2) in a mold, pouring cast steel molten metal to form the substrate (3), and combining the substrate (3) with the first wear-resistant body (1) and the two second wear-resistant bodies (2) to form the spectacle plate.

7. The preparation method of the spectacle plate for a concrete pump truck of claim 6, wherein particle sizes of the zirconia powder, the alumina powder and the silicon carbide powder range from 0.02 mm to 0.1 mm.

8. The preparation method of the spectacle plate for a concrete pump truck of claim 6 or 7, wherein a particle size of the tungsten carbide powder ranges from 5 μ m to 10 μ m.

9. The preparation method of the spectacle plate for a concrete pump truck of any one of claims 6-8, wherein a mass ratio of the combination of at least two of the zirconia powder, the alumina powder and the silicon carbide to the iron powder ranges from 1:1 to 3:1.

10. The preparation method of the spectacle plate for a concrete pump truck of any one of claims 6-9, wherein a mass ratio of the tungsten carbide powder to the combination of at least two of the zirconia powder, the alumina powder and the silicon carbide powder is less than 20%.

11. The preparation method of the spectacle plate for a concrete pump truck of any one of claims 6-10, wherein the tungsten carbide powder, the iron powder and at least two of the zirconia powder, the alumina powder and the silicon carbide powder are mixed and placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for a first preset time period after completely molten iron is obtained; and then cooling is conducted to obtain the first wear-resistant body (1).

12. The preparation method of the spectacle plate for a concrete pump truck of any one of claims 6-11, wherein the iron powder and at least two of the zirconia powder, the alumina powder and the silicon carbide powder are mixed and placed in a furnace and heated to 1350°C-1480°C, and the temperature is maintained for a second preset time period after completely molten iron is obtained; and then cooling is conducted to obtain the second wear-resistant body (2).

13. The preparation method of the spectacle plate for a concrete pump truck of any one of claims 6-12, wherein cast steel is heated to 1500°C-1550°C to form the cast steel molten metal, and the cast steel molten metal is poured into the mold at 1480°C-1520°C to form the substrate (3).

14. A concrete pump truck, comprising the spectacle plate for a concrete pump truck of any one of claims 1-5.