

DOUBLE-WHEEL SLOT MILLING MACHINE AND DEVIATION RECTIFYING DEVICE THEREOF

Cross-Reference to Related Applications

[0001] The present application is based on and claims priority of an application with a filing number of 202011057193.6 and a filing date of September 29, 2020, the disclosure of which is entirely incorporated herein by reference.

Field of the Invention

[0002] The present disclosure relates to a field of engineering machinery, and particularly to a double-wheel slot milling machine and a deviation rectifying device thereof.

Background of the Invention

[0003] The double-wheel slotting machine is an underground continuous wall slotting device, with a maximum construction depth of more than 150m. In order to improve a slotting accuracy at a large depth, the double-wheel slotting machine is provided with a deviation rectifying device, which can rectify a deviation of a mill support in real time when the mill support is inclined due to reasons such as a stratum change.

Summary of the Invention

[0004] In related arts acquired by the inventor, during hard rock milling, a rock protrusion, i.e., a milling ‘blind zone’, will be left in a middle of a rock wall due to a rock breaking mechanism of a milling wheel. On the one hand, the rock protrusion will extrude a push plate of a deviation rectifying device during rectification, resulting in a deformation of the push plate, which affects a deviation rectifying stability and a grooving precision. On the other hand, the rock protrusion may lead to jamming of a mill support, which affects a hard rock milling efficiency.

[0005] In view of the above issues, the present disclosure provides a double-wheel slot milling machine and a deviation rectifying device thereof, so as to improve a deviation rectifying stability and a slotting precision of the deviation rectifying device.

[0006] A first aspect of the present disclosure provides a deviation rectifying device of a double-wheel slot milling machine, comprising:

[0007] a push plate, comprising a bottom plate, and a top plate which is located above the bottom plate and provided with an avoidance slot penetrating along a longitudinal direction.

[0008] In some embodiments, the top plate comprises two sub-top plates located on two sides of the avoidance slot, respectively, and a gap between the two sub-top plates forms the avoidance slot.

[0009] In some embodiments, the avoidance slot penetrates the top plate in a thickness direction thereof.

[0010] In some embodiments, the deviation rectifying device further comprises a deviation rectifying body located at a lower side of the push plate, the bottom plate being rotatably connected to the deviation rectifying body, and an upper longitudinal end of the bottom plate being bent toward the deviation rectifying body to cover a space between the bottom plate and the deviation rectifying body.

[0011] In some embodiments, the avoidance slot comprises a flared section located at a lower longitudinal end.

[0012] In some embodiments, the avoidance slot comprises a flared section located at an upper longitudinal end.

[0013] In some embodiments, the push plate comprises two sub-top plates located on two sides of the avoidance slot, respectively, and an upper surface of each of the sub-top plates comprises inclined sections located at the longitudinal ends.

[0014] A second aspect of the present disclosure provides a double-wheel slot milling machine, comprising the deviation rectifying device provided in the first aspect of the present disclosure.

[0015] In some embodiments, the double-wheel slot milling machine further comprises a mill support and milling wheels provided at a bottom of the mill support, wherein the mill support has a quadrate structure and comprises two opposite first lateral surfaces parallel to an axis of the milling wheel and two opposite second lateral surfaces perpendicular to the axis of the milling wheel, and the first lateral surfaces are provided with the deviation rectifying devices.

[0016] Based on the technical solutions provided by the present disclosure, the deviation rectifying device comprises a push plate, and a top plate of the push plate is provided with an avoidance slot penetrating along a longitudinal direction. During operation of the deviation rectifying device of the present disclosure, a rock wall protrusion on a slot wall will enter the avoidance slot to prevent the push plate of the deviation rectifying device from being extruded with the rock wall protrusion, thereby avoiding a deviation rectifying stability and a slotting precision from being affected.

[0017] Other features and advantages of the present disclosure will be clearer from the following detailed

description of the exemplary embodiments of the present disclosure with reference to the accompanying drawings.

Brief Description of the Drawings

[0018] In order to more clearly explain the technical solutions in the embodiments of the present disclosure or in the prior art, the drawings required in the description of the embodiments or the prior art will be briefly introduced below. Obviously, the drawings concerned in the following description just illustrate some embodiments of the present disclosure, and any other drawing can be obtained by those of ordinary skills in the art according to these drawings without paying creative labor.

[0019] FIG. 1 is a schematic diagram of a front view structure of a double-wheel slot milling machine according to an embodiment of the disclosure;

[0020] FIG. 2 is a schematic diagram of a side view structure of the double-wheel slot milling machine according to the embodiment illustrated in FIG. 1;

[0021] FIG. 3 is a schematic diagram of when a mill support of the double-wheel slot milling machine according to the embodiment illustrated in FIG. 1 is inclined;

[0022] FIG. 4 is a schematic diagram of a top view enlarged structure of the double-wheel slot milling machine according to the embodiment illustrated in FIG. 1;

[0023] FIG. 5 is a schematic diagram of a structure of a first deviation rectifying device on a mill support according to an embodiment of the present disclosure;

[0024] FIG. 6 is a schematic diagram of a front view structure of the first deviation rectifying device in FIG. 5; and

[0025] FIG. 7 is a schematic diagram of a side view structure of the first deviation rectifying device in FIG. 5.

Detailed Description of the Embodiments

[0026] In order that the objectives, technical solutions and advantages of the present disclosure are clearer, the embodiments of the present disclosure will be further described in detail through the following embodiments with reference to the drawings. It should be understood that the specific embodiments described here are only used to explain rather than limiting the present disclosure.

[0027] As illustrated in FIGS. 1 and 2, the double-wheel slot milling machine of this embodiment comprises

a mill support 4, milling wheels 6 provided at a bottom of the mill support 4, and deviation rectifying devices provided on lateral surfaces of the mill support 4. The double-wheel slot milling machine is located within slot walls 5.

[0028] As illustrated in FIG. 3, when the mill support 4 is inclined within the slot walls, push plates of the deviation rectifying devices located at a lower left corner and an upper right corner are respectively pushed out in directions indicated by arrows under actions of respective oil cylinders (each push-out direction is perpendicular to a side plate of the mill support) until the push plates abut against the slot walls, at which time the slot walls generate reaction forces on the push plates. As the oil cylinders and the push plates are continually pushed out, the reaction forces generated by the slot walls on the push plates of the deviation rectifying devices will make the mill support 4 rotate counterclockwise until achieving a vertical state.

[0029] The mill support 4 of the double-wheel slot milling machine of this embodiment has a quadrate structure and comprises four lateral surfaces circumferentially enclosing. The four lateral surfaces comprise two first lateral surfaces parallel to an axis of the milling wheels 6 and two second lateral surfaces perpendicular to the axis of the milling wheels 6. The first lateral surface is provided with a first deviation rectifying device 1, and the second lateral surface is provided with a second deviation rectifying device 2. As illustrated in FIG. 4, a first rock wall protrusion 51 is formed on a first slot wall parallel to the axis of the milling wheel 6, and a second rock wall protrusion 52 is formed on a second slot wall perpendicular to the axis of the milling wheel 6. The two second deviation rectifying devices 2 located on a same lateral surface of the mill support 4 are located on two sides of the second rock wall protrusion 52, respectively. During operation, the second deviation rectifying device 2 and the second rock wall protrusion 52 are separated from each other, so the second rock wall protrusion 52 has no influence on the action of the second deviation rectifying device 2. However, the first rock wall protrusion 51 is located in a middle of the first deviation rectifying device 1, so the first rock wall protrusion 51 will adversely affect the deviation rectification by the first deviation rectifying device 1.

[0030] In order to solve the above problem, as illustrated in FIGS. 5 to 7, an embodiment of the present disclosure improves the first deviation rectifying device 1, which comprises a push plate 12 provided with an avoidance slot 124 penetrating along a longitudinal direction X.

[0031] During operation of the first deviation rectifying device 1 of the embodiment of the present disclosure, referring to FIG. 4, the first rock wall protrusion 51 on the slot wall 5 will enter the avoidance slot 124, so as to prevent the push plate 12 of the first deviation rectifying device 1 from being extruded with the

first rock wall protrusion 51, thereby avoiding a deviation rectifying stability and a slotting precision from being affected. In addition, while avoiding the rock wall protrusion, the push plate 12 of this embodiment changes a contact between a plane of the push plate and the rock wall from a point contact to a double-parallel-line contact, thereby improving the deviation rectifying stability.

[0032] Specifically, in this embodiment, as illustrated in FIG. 6, the push plate 12 comprises a bottom plate 121, and a top plate located on the bottom plate 121 and provided with the avoidance slot 124.

[0033] In this embodiment, the bottom plate 121 and the top plate are separately provided, and the top plate being located on the bottom plate 121 means that the top plate of this embodiment is stacked above the bottom plate 121 in a thickness direction. In addition, the top plate of this embodiment is connected to the bottom plate 121 by a connecting device 123, which is a detachable structure or a non-detachable structure.

[0034] However, in other embodiments not illustrated in the drawings, the bottom plate and the top plate are integrally provided to form the push plate, and there is no distinction between the bottom plate and the top plate in the thickness direction of the push plate. The avoidance slot can be directly opened at an upper side in the thickness direction of the push plate. For example, the integrally provided push plate may be manufactured by forging, etc.

[0035] In some embodiments, the top plate comprises two sub-top plates 122 located on two sides of the avoidance slot 124, respectively, and a gap between the two sub-top plates 122 forms the avoidance slot 124. Specifically, in this embodiment, as illustrated in FIG. 6, the two sub-top plates 122 are provided independently. In addition, the two sub-top plates 122 are respectively connected to two transverse sides of the bottom plate 121 by the connecting device 123. At this time, the avoidance slot 124 directly penetrates the top plate in the thickness direction thereof.

[0036] In other embodiments, the top plate may also comprise more than three sub-plates which are independently provided, as long as the avoidance slot can be constructed, and the number of the sub-plates is not limited.

[0037] In other embodiments not illustrated in the drawings, the two sub-top plates are integrally provided. At this time, the two sub-top plates are integral and connected to each other. For example, a slot avoidance may be directly opened in the middle of the top plate. In addition, the avoidance slot may or may not penetrate in the thickness direction of the top plate, as long as either of a width and a depth of the avoidance slot is greater than either of a width and a height of the first rock wall protrusion to achieve the avoidance effect.

[0038] The avoidance slot 124 of this embodiment is configured to accommodate the first rock wall

protrusion 51 to achieve the avoidance effect. Specifically, in this embodiment, either of the width and the depth of the avoidance slot 124 is greater than either of the height and the width of the first rock wall protrusion 51 to achieve the avoidance effect.

[0039] The side walls of the avoidance slot 124 of this embodiment are formed by the lateral surfaces of the sub-top plates 122 provided at the two sides. In this embodiment, the lateral surface of the sub-top plate 122 is inclined with respect to an upper surface thereof. Specifically, an obtuse angle is formed between the lateral surface of the sub-top plate 122 and the upper surface thereof.

[0040] As illustrated in FIG. 6, the avoidance slot 124 of this embodiment comprises a flared section 1241 located at a lower longitudinal end. During operation of the first deviation rectifying device 1, the first rock wall protrusion 51 enters the avoidance slot 124 from the flared section 1241. The flared section 1241 is provided to ensure that the first rock wall protrusion 51 enters the avoidance slot 124 smoothly without being stuck by the avoidance slot 124.

[0041] The avoidance slot 124 of this embodiment further comprises a flared section located at an upper longitudinal end, so that upper and lower deviation rectifying devices of this embodiment are symmetrical with respect to each other, without needing to be distinguished during mounting, thereby improving the efficiency.

[0042] As illustrated in FIG. 7, the upper surface of the sub-top plate 122 of this embodiment comprises inclined sections 1221 at the longitudinal ends, so as to reduce a shearing force acting on the sub-top plate 122 and the connecting device 123 during milling, and prevent the sub-top plate 122 and the connecting device 123 from being damaged.

[0043] Preferably, a plane section 1222 of the upper surface of the sub-top plate 122 is smoothly connected to the inclined sections 1221, so that the inclined sections 1221 are streamlined.

[0044] The deviation rectifying device of this embodiment further comprises a deviation rectifying body 11 provided at a lower side of the push plate 12. The bottom plate 121 is rotatably connected to the deviation rectifying body 11. In this embodiment, an upper end of the bottom plate 121 is bent toward the deviation rectifying body 11 to cover a space between the bottom plate 121 and the deviation rectifying body 11. In an operation state, the bending can prevent falling stones from extruding an internal structure of the deviation rectifying device during milling. Specifically, in this embodiment, the deviation rectifying body 11 comprises a base and a plurality of internal structures, such as four-bar linkages, oil cylinders, etc., which are provided between the bottom plate 121 and the base. Therefore, in order to protect the plurality of internal structures, the upper end of the bottom plate 121 of this embodiment is bent.

[0045] Preferably, the lower end of the bottom plate 121 of this embodiment is also bent. The second deviation rectifying device 2 may have the same structure as the first deviation rectifying device 1 of the above embodiment. However, since the second rock wall protrusion 52 does not affect the operation of the second deviation rectifying device 2, the push plate of the second deviation rectifying device 2 may also be provided as a flat plate structure without a slot.

[0046] It should be noted that when an element is referred to as being 'fixed' to another element, it may be directly on another element or there may be an intervening element. When an element is considered as being 'connected' to another element, it may be directly connected to another element or there may be an intervening element at the same time. On the contrary, when an element is referred to as being 'directly on' another element, there is no intervening element. The terms 'vertical', 'horizontal', 'left', 'right' and similar expressions used herein are for illustrative purposes only.

[0047] In the description of the present disclosure, the terms 'first' and 'second' are used for illustrative purposes only, and cannot be understood as indicating or implying any relative importance.

[0048] Meanwhile, the terms such as 'upper', 'lower', 'left', 'right', 'middle' and 'a (an)' cited herein are merely for the convenience of description, rather than limiting the implementable scope of the present disclosure. When there is no substantial change of the technical content, any variation or adjustment of a relative relationship of those terms should also be regarded as falling within the implementable scope of the present disclosure.

[0049] Those described above are just several embodiments of the present disclosure, and although their descriptions are specific and detailed, they should not be construed as limitations to the scope of the present disclosure. To be pointed out, many modifications and improvements can be made by persons of ordinary skills in the art without departing from the concept of the present disclosure, and also fall within the protection scope of the present disclosure. Therefore, the protection scope of the present disclosure should be subjected to the appended claims.

Claims

1. A deviation rectifying device of a double-wheel slot milling machine, comprising:
a push plate (12), comprising a bottom plate (121) and a top plate which is located above the bottom plate (121) and provided with an avoidance slot (124) penetrating along a longitudinal direction (X), and
2. The deviation rectifying device of the double-wheel slot milling machine according to claim 1, wherein the top plate comprises two sub-top plates (122) located on two sides of the avoidance slot (124), respectively, and a gap between the two sub-top plates (122) forms the avoidance slot (124).
3. The deviation rectifying device of the double-wheel slot milling machine according to claim 1 or 2, wherein the avoidance slot (124) penetrates the top plate in a thickness direction thereof.
4. The deviation rectifying device of the double-wheel slot milling machine according to any one of claims 1 to 3, further comprising a deviation rectifying body (11) located at a lower side of the push plate (12), the bottom plate (121) being rotatably connected to the deviation rectifying body (11), and an upper longitudinal end of the bottom plate (121) being bent toward the deviation rectifying body (11) to cover a space between the bottom plate (121) and the deviation rectifying body (11).
5. The deviation rectifying device of the double-wheel slot milling machine according to any one of claims 1 to 4, wherein the avoidance slot (124) comprises a flared section (1241) located at a lower longitudinal end.
6. The deviation rectifying device of the double-wheel slot milling machine according to claim 5, wherein the avoidance slot (124) comprises a flared section (1241) located at an upper longitudinal end.
7. The deviation rectifying device of the double-wheel slot milling machine according to any one of claims 1 to 6, wherein the push plate (12) comprises two sub-top plates (122) located on two sides of the avoidance slot (124), respectively, and an upper surface of each of the sub-top plates (122) comprises inclined sections (1221) located at the longitudinal ends.

8. A double-wheel slot milling machine, comprising the deviation rectifying device of the double-wheel slot milling machine according to any one of claims 1 to 7.

9. The double-wheel slot milling machine according to claim 8, further comprising a mill support (4) and milling wheels (6) provided at a bottom of the mill support (4), wherein the mill support (4) has a quadrate structure and comprises two opposite first lateral surfaces parallel to an axis of the milling wheel (6) and two opposite second lateral surfaces perpendicular to the axis of the milling wheel (6), and the first lateral surfaces are provided with the deviation rectifying devices.