

GLOBOID CAM TECHNOLOGY-BASED ATC MECHANISM

TECHNICAL FIELD

[0001] The present invention relates to the field of computer numerical control (CNC) machine tool technology, specifically to a globoid cam technology-based automatic tool changer (ATC) mechanism.

BACKGROUND

[0002] CNC machine tools are one of the most widely used CNC machining equipment. They are mainly used for cutting and machining of inner and outer cylindrical surfaces, inner and outer conical surfaces of arbitrary cone angles, complex inner and outer curved surfaces, and cylindrical and conical threads of shaft parts or disc parts, and can perform grooving, drilling, expanding, reaming and boring, etc.

[0003] When using CNC machine tools, it is often necessary to use ATC technology to change the tools in order to meet different machining requirements. However, existing ATC mechanisms generally use a tool changing arm to remove the tool, and then rotates the tool changing arm to install the tool at the other end. This method of tool change requires accurate positioning during tool removal and installation. Any slight errors in positioning can lead to tool change failure, and higher precision means higher failure rates. The use of higher precision equipment will also increase the cost of the tool changing mechanism. At the same time, this type of tool changing equipment requires more steps, leading to long tool changing time, and is not conducive to continuous machining operations. Therefore, we propose a globoid cam technology-based ATC mechanism which adopts a push-type tool changing method to improve the tool changing efficiency without the need for high-precision positioning.

SUMMARY

[0004] The present invention aims to solve one of the technical problems existing in the prior art or related technology.

[0005] To this end, the present invention adopts technical solutions described below.

[0006] A globoid cam technology-based ATC mechanism, comprising: a body assembly, a tool changing assembly, a positioning assembly and a fixing assembly; wherein the body assembly comprises a hydraulic rod installed in a CNC machine tool, a servo motor fixed to the driving end of the hydraulic rod, a tool disc fixed to the driving end of the servo motor, and a machining spindle provided on the side of the tool disc; wherein the tool changing assembly is provided on the tool disc, comprising a rotator installed in the middle of the tool disc, a first cylinder provided on the side of the machining spindle and facing the machining spindle, a push plate fixed to the driving end of the first cylinder, a slot provided in the push plate, a push block embedded in the push plate and located on the side of the slot, a second cylinder fixed to the push block and located above the first cylinder, an electric lifting rod installed on the push plate and located on both sides of the slot, a mounting plate fixed to the driving end of the electric lifting rod, an electromagnet installed at the bottom of the mounting plate, an opening provided in the mounting plate and the electromagnet, and an electromagnetic controller installed on the mounting plate and electrically connected to the electromagnet; wherein the positioning assembly is provided on the tool disc and the machining spindle, comprising a storage groove provided on the side edge of the tool disc, a spring installed in the storage groove, a first positioning plate fixed to the end of the spring and clamped in the storage groove, a first magnetic block provided on both sides of the top of the first positioning plate, a tool attracted and fixed on the outside of the first positioning plate, a positioning groove provided on the tool and adapted to the first positioning plate, a second magnetic block provided in the positioning groove and adapted to be attracted by the first magnetic block, a guide groove provided on the machining spindle, a second positioning plate provided in the middle of the guide groove, and a third magnetic block provided on both sides of the second positioning plate; and wherein the fixing assembly is provided on the machining spindle and configured to fix the tool.

[0007] In a preferred embodiment of the present invention, the fixing assembly comprises an air hole provided in the machining spindle and located on both sides of the tool, an air pump assembled to the machining spindle and connected to the air hole by a pipeline, a protective valve installed in the machining spindle and connected to the air pump by a pipeline, a piston plate provided in the air hole, and a fixing plate fixed on the piston plate.

[0008] In a preferred embodiment of the present invention, the rotator drives the first cylinder to

always face the guide groove.

[0009] In a preferred embodiment of the present invention, both sides of the tool and the inner side of the slot are adapted arc-shaped structures.

[0010] In a preferred embodiment of the present invention, the first positioning plate and the second positioning plate are respectively adapted to the positioning groove in an inverted trapezoidal structure, and both sides of the top of the first positioning plate are provided with an inclined surface flush with the tool disc.

[0011] In a preferred embodiment of the present invention, an end of the guide groove facing the tool disc is a flared structure.

[0012] In a preferred embodiment of the present invention, a tool changing groove is provided at the midpoint of the guide groove passing through the machining spindle.

[0013] In a preferred embodiment of the present invention, a fixing groove is provided on the side of the guide groove for the insertion of the fixing plate.

[0014] The above technical solutions of the present invention have the following beneficial technical effects.

[0015] 1. With the tool changing assembly and the positioning assembly, the present invention can use the first cylinder to push the tool into the guide groove, and then use the second cylinder to continue to push the tool to move, and push the tool to be replaced on the machining spindle to the tool changing groove. At this time, the replaced tool is magnetically fixed on the outside of the second positioning plate. At this time, the electromagnet is located above the tool changing groove, and the electromagnet is used to generate electromagnetic attraction for the replaced tool. Then the first cylinder moves the tool to the top of the first positioning plate. After the electromagnet is de-energized, the tool falls on the first positioning plate and is fixed by magnetic attraction. This tool changing method requires low precision, and the loading and unloading of the tool are completed after one advancement and contraction, thus the tool changing efficiency is high.

[0016] 2. With the fixing assembly, the present invention can set the fixing plate on both sides of the tool after the tool changing is completed, so as to reinforce the tool and ensure the stability of the tool during use.

BRIEF DESCRIPTION OF DRAWINGS

[0017] FIG. 1 is a front view of an ATC mechanism according to an embodiment of the present invention;

[0018] FIG. 2 is a side view of an ATC mechanism according to an embodiment of the present invention;

[0019] FIG. 3 is a partial enlarged side view of an ATC mechanism according to an embodiment of the present invention;

[0020] FIG. 4 is a schematic diagram of the structure of the fixing assembly according to an embodiment of the present invention;

[0021] FIG. 5 is a partial enlarged front view of an ATC mechanism according to an embodiment of the present invention; and

[0022] FIG. 6 is a schematic diagram of the structure of the second positioning plate according to an embodiment of the present invention.

[0023] Reference signs:

[0024] 100 body assembly; 110 hydraulic rod; 120 servo motor; 130 tool disc; 140 machining spindle;

[0025] 200 tool changing assembly; 210 rotator; 220 first cylinder; 230 push plate; 240 slot; 250 push block; 260 second cylinder; 270 electric lifting rod; 280 mounting plate; 290 electromagnet; 201 opening; 202 electromagnetic controller;

[0026] 300 positioning assembly; 310 storage groove; 320 spring; 330 positioning plate 1; 340 first magnetic block; 350 tool; 360 positioning groove; 370 second magnetic block; 380 guide groove; 381 tool changing groove; 382 fixing groove; 390 second positioning plate; 301 third magnetic block;

[0027] 400 fixing assembly; 410 air hole; 420 air pump; 430 protective valve; 440 piston plate; 450 fixing plate.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0028] In order to make the objectives, technical solutions and advantages of the present

invention clearer, the present invention is further described in detail in combination with specific embodiments and with reference to the accompanying drawings. It should be noted that the embodiments of the present invention and the features in the embodiments can be combined with each other without conflict.

[0029] The following describes a globoid cam technology-based ATC mechanism provided by some embodiments of the present invention in combination with the accompanying drawings.

[0030] Embodiment 1:

[0031] As shown in FIGS. 1-6, the present invention provides a globoid cam technology-based ATC mechanism, comprising: a body assembly 100, a tool changing assembly 200, a positioning assembly 300 and a fixing assembly 400.

[0032] The body assembly 100 comprises a hydraulic rod 110 installed in a CNC machine tool, a servo motor 120 fixed to the driving end of the hydraulic rod 110, a tool disc 130 fixed to the driving end of the servo motor 120, and a machining spindle 140 provided on the side of the tool disc 130.

[0033] Specifically, when the tool is changed, the hydraulic rod 110 drives the tool disc 130 to approach the machining spindle 140, making it easier to change the tool. The servo motor 120 drives the tool disc 130 to rotate, so that the required tool 350 is located on the side of the guide groove 380. The machining spindle 140 is the machining spindle of the CNC machine tool.

[0034] The tool changing assembly 200 is provided on the tool disc 130, comprising a rotator 210 installed in the middle of the tool disc 130, a first cylinder 220 provided on the side of the machining spindle 140 and facing the machining spindle 140, a push plate 230 fixed to the driving end of the first cylinder 220, a slot 240 provided in the push plate 230, a push block 250 embedded in the push plate 230 and located on the side of the slot 240, a second cylinder 260 fixed to the push block 250 and located above the first cylinder 220, an electric lifting rod 270 installed on the push plate 230 and located on both sides of the slot 240, a mounting plate 280 fixed to the driving end of the electric lifting rod 270, an electromagnet 290 installed at the bottom of the mounting plate 280, an opening 201 provided in the mounting plate 280 and the electromagnet 290, and an electromagnetic controller 202 installed on the mounting plate 280 and electrically connected to the electromagnet 290.

[0035] Specifically, the rotator 210 drives the cylinder 1 220 to always face the guide groove 380.

When the servo motor 120 drives the tool disc 130, the first cylinder 220 is also driven to rotate. Each time the tool is changed, the rotator 210 needs to be used to adjust the first cylinder 220 to the position aligned with the guide groove 380 to achieve linear advancement for the tool change.

[0036] Further, the opening 201 is adapted to the cutter head on the tool 350, so that the cutter head passes through the electromagnet 290 after the electromagnet 290 magnetically attracts the tool. There may be some error in using magnetic positioning. Even if the positioning is not accurate, the tool 350 can be fixed and will be attracted by the magnetic force to move to the fitting position.

[0037] The positioning assembly 300 is provided on the tool disc 130 and the machining spindle 140, comprising a storage groove 310 provided on the side edge of the tool disc 130, a spring 320 installed in the storage groove 310, a first positioning plate 330 fixed to the end of the spring 320 and clamped in the storage groove 310, a first magnetic block 340 provided on both sides of the top of the first positioning plate 330, a tool 350 attracted and fixed on the outside of the first positioning plate 330, a positioning groove 360 provided on the tool 350 and adapted to the first positioning plate 330, a second magnetic block 370 provided in the positioning groove 360 and adapted to be attracted by the first magnetic block 340, a guide groove 380 provided on the machining spindle 140, a second positioning plate 390 provided in the middle of the guide groove 380, and a third magnetic block 301 provided on both sides of the second positioning plate 390.

With the tool changing assembly 200 and the positioning assembly 300, the present invention can use the first cylinder 220 to push the tool 350 into the guide groove 380, and then use the second cylinder 260 to continue to push the tool 350 to move, and push the tool 350 to be replaced on the machining spindle 140 to the tool changing groove 381. At this time, the replaced tool 350 is magnetically fixed on the outside of the second positioning plate 390. At this time, the electromagnet 290 is located above the tool changing groove 381, and the electromagnet 290 is used to generate electromagnetic attraction for the replaced tool 350. Then the first cylinder 220 moves the tool 350 to the top of the first positioning plate 330. After the electromagnet 290 is de-energized, the tool 350 falls on the first positioning plate 330 and is fixed by magnetic attraction. This tool changing method requires low precision, and the loading and unloading of the tool are completed after one advancement and contraction, thus the tool changing efficiency is high.

[0038] Specifically, both sides of the tool 350 and the inner side of the slot 240 are adapted arc-shaped structures, so that the tool 350 can automatically shift to the center of the guide groove 380

after entering the guide groove 380. The tool change is not affected under a certain error. Of course, the higher the precision, the better.

[0039] Further, an end of the guide groove 380 facing the tool disc 130 is a flared structure, which allows the tool 350 to enter the guide groove 380 even if there is an alignment error. During this process, the machining spindle 140 will be forced to rotate in a non-self-locking state to complete the correction.

[0040] On the other hand, a tool changing groove 381 is provided at the midpoint of the guide groove 380 passing through the machining spindle 140. The tool change grooving 381 is positioned to accommodate the replaced tool 350. When the tool change is completed, the electromagnet 290 on the mounting plate 280 is located above the tool changing groove 381, and the cutter head of the tool 350 corresponds to the opening 201. At this time, the electromagnet 290 is energized to generate magnetic force to forcefully suck out the tool 350 to complete the tool change.

[0041] Further, a fixing groove 382 is provided on the side of the guide groove 380 for the insertion of the fixing plate 450, which can improve the fixing strength of the fixing plate 450 and prevent one end of the fixing plate 450 from being deformed by force.

[0042] Embodiment 2:

[0043] As shown in FIG. 6 and based on Embodiment 1, the first positioning plate 330 and the second positioning plate 390 are respectively adapted to the positioning groove 360 in an inverted trapezoidal structure, and both sides of the top of the first positioning plate 330 are provided with an inclined surface flush with the tool disc 130, preventing the tool 350 from falling out when positioned on the first positioning plate 330 and the second positioning plate 390, thereby improving the stability of the tool 350.

[0044] It should be noted that the second positioning plate 390 can be extended to the side edge of the machining spindle 140 and connected as closely as possible with the positioning plate 330. When the tool 350 just separates from the positioning plate 330, it gets stuck on the second positioning plate 390, improving the stability of the tool 350 during the tool change process.

[0045] Embodiment 3:

[0046] As shown in FIGS. 1 and 4 and based on Embodiment 1, the fixing assembly 400 is provided on the machining spindle 140 for fixing the tool 350. The fixing assembly 400 comprises an air hole 410 provided on the machining spindle 140 and located on both sides of the tool 350,

an air pump 420 assembled to the machining spindle 140 and connected to the air hole 410 by a pipeline, a protective valve 430 installed in the machining spindle 140 and connected to the air pump 420 by a pipeline, a piston plate 440 provided in the air hole 410, and a fixing plate 450 fixed on the piston plate 440. With the fixing assembly 400, the fixing plate 450 can be provided on both sides of the tool 350 after the tool change is completed to reinforce the tool 350 and ensure the stability of the tool 350 during use.

[0047] Specifically, when the tool is changed, the air pump 420 discharges the air in the air hole 410, retracting the fixing plate 450 into the air hole 410, and then inflates the air hole to discharge the fixing plate 450 after the tool change is completed to reinforce the tool 350 on both sides to ensure the machining stability.

[0048] The working principle and use process of the present invention are described below. First, the hydraulic rod 110 pushes the tool disc 130 close to the machining spindle 140, and then the servo motor 120 drives the tool disc 130 to rotate, so that the required tool 350 on the tool disc 130 is located on the side of the guide groove 380 on the machining spindle 140. Then the first cylinder 220 pushes the tool 350 into the guide groove 380, and the first positioning plate 330 is compressed and retracted into the storage groove 310 during this process. Then the second cylinder 260 is used to drive the push block 250 to continue to push the tool 350 to move to the middle of the guide groove 380 until the current tool 350 pushes the tool 350 to be replaced on the machining spindle 140 to the position of the tool changing groove 381. At this time, the replaced tool 350 is magnetically fixed on the outside of the second positioning plate 390. The electromagnet 290 is located above the tool changing groove 381 and is used to generate electromagnetic attraction for the replaced tool 350. Then the first cylinder 220 moves the tool 350 to the top of the first positioning plate 330, and cooperates with the electric lifting rod 270 to adjust the height of the mounting plate 280. After the electromagnet 290 is de-energized, the tool 350 falls on the first positioning plate 330 and is fixed by magnetic attraction. In this way, the tool change is realized.

[0049] Although the embodiments of the present invention have been shown and described, those skilled in the art may understand that various changes, modifications, substitutions and variations can be made to these embodiments without departing from the principles and purposes of the present invention, and the scope of the present invention is defined by the claims and their equivalents.

What is claimed is:

1. A globoid cam technology-based ATC mechanism, comprising: a body assembly (100), a tool changing assembly (200), a positioning assembly (300) and a fixing assembly (400),

wherein the body assembly (100) comprises a hydraulic rod (110) installed in a CNC machine tool, a servo motor (120) fixed to the driving end of the hydraulic rod (110), a tool disc (130) fixed to the driving end of the servo motor (120), and a machining spindle (140) provided on the side of the tool disc (130);

wherein the tool changing assembly (200) is provided on the tool disc (130), comprising a rotator (210) installed in the middle of the tool disc (130), a first cylinder (120) provided on the side of the machining spindle (140) and facing the machining spindle (140), a push plate (230) fixed to the driving end of the first cylinder (220), a slot (240) provided in the push plate (230), a push block (250) embedded in the push plate (230) and located on the side of the slot (240), a second cylinder (260) fixed to the push block (250) and located above the first cylinder (220), an electric lifting rod (270) installed on the push plate (230) and located on both sides of the slot (240), a mounting plate (280) fixed to the driving end of the electric lifting rod (270), an electromagnet (290) installed at the bottom of the mounting plate (280), an opening (201) provided in the mounting plate (280) and the electromagnet (290), and an electromagnetic controller (202) installed on the mounting plate (280) and electrically connected to the electromagnet (290);

wherein the positioning assembly (300) is provided on the tool disc (130) and the machining spindle (140), comprising a storage groove (310) provided on the side edge of the tool disc (130), a spring (320) installed in the storage groove (310), a first positioning plate (330) fixed to the end of the spring (320) and clamped in the storage groove (310), a first magnetic block (340) provided on both sides of the top of the first positioning plate (330), a tool (350) attracted and fixed on the outside of the first positioning plate (330), a positioning groove (360) provided on the tool (350) and adapted to the first positioning plate (330), a second magnetic block (370) provided in the positioning groove (360) and adapted to be attracted by the first magnetic block (340), a guide groove (380) provided on the machining spindle (140), a second positioning plate (390) provided in the middle of the guide groove (380), and a third magnetic block (301) provided on both sides

of the second positioning plate (390); and

wherein the fixing assembly (400) is provided on the machining spindle (140) and configured to fix the tool (350).

2. The globoid cam technology-based ATC mechanism according to claim 1, wherein the fixing assembly (400) comprises an air hole (410) provided in the machining spindle (140) and located on both sides of the tool (350), an air pump (420) assembled to the machining spindle (140) and connected to the air hole (410) by a pipeline, a protective valve (430) installed in the machining spindle (140) and connected to the air pump (420) by a pipeline, a piston plate (440) provided in the air hole (410), and a fixing plate (450) fixed on the piston plate (440).

3. The globoid cam technology-based ATC mechanism according to claim 1, wherein the rotator (210) drives the first cylinder (220) to always face the guide groove (380).

4. The globoid cam technology-based ATC mechanism according to claim 1, wherein both sides of the tool (350) and the inner side of the slot (240) are adapted arc-shaped structures.

5. The globoid cam technology-based ATC mechanism according to claim 1, wherein the first positioning plate (330) and the second positioning plate (390) are respectively adapted to the positioning groove (360) in an inverted trapezoidal structure, and both sides of the top of the first positioning plate (330) are provided with an inclined surface flush with the tool disc (130).

6. The globoid cam technology-based ATC mechanism according to claim 1, wherein an end of the guide groove (380) facing the tool disc (130) is a flared structure.

7. The globoid cam technology-based ATC mechanism according to claim 1, wherein a tool changing groove (381) is provided at the midpoint of the guide groove (380) passing through the machining spindle (140).

8. The globoid cam technology-based ATC mechanism according to claim 2, wherein a fixing

groove (382) is provided on the side of the guide groove (380) for the insertion of the fixing plate (450).