STAMPING DEVICE FOR UNMANNED AERIAL VEHICLE WING PRODUCTION

TECHNICAL FIELD

The present invention relates to the technical field of unmanned aerial vehicle (UAV) wing production, and particularly to a stamping device for UAV wing production.

BACKGROUND

The stamping technology for UAV wing ribs involves processing metal sheets into complex, rib-shaped components through the use of stamping dies, which support and enhance the strength and rigidity of UAV wings. This technology demands high precision and uniform material deformation to ensure that the ribs possess excellent structural performance and anti-deformation capability during flight. With the advancement of UAV technology, the rib stamping process has been continuously optimized, resulting in improved production efficiency, reduced weight, and enhanced stability and reliability of the overall wing structure.

The Chinese Patent Publication No. CN114918298A provides a tail stamping device for UAV wing production. This invention provides a tail stamping device for UAV wing production capable of automatic stamping, automatic positioning of wing steel plates, and high safety. The tail stamping device for UAV wing production includes a base plate, a support, an operation panel, a heat conduction plate, a cylinder, a first connecting rod, and a first pressing plate. The support is mounted on the top of the base plate; the operation plate is mounted on the top of the support; and the heat conduction plate is mounted in the middle of the operation panel. The present invention has the following beneficial effects. The cylinder can drive the first pressing plate to stamp the wing plate to be stamped, thereby realizing the function of automatically stamping the wing plate and reducing labor costs. Through a positioning mechanism, the position of the wing plate to be stamped can be limited. Through a receiving mechanism, the stamped wing plate can be collected. Nevertheless, the aforementioned patent document still exhibits the following shortcomings during implementation.

Although the aforementioned patent can perform positioning and collection of the wing plate during implementation, it is incapable of uniformly heating the wing blank before stamping, and simultaneously cannot apply lubricating oil to the outer surface of the wing blank during the feeding process.

SUMMARY

A primary objective of the present invention is to provide a stamping device for UAV wing

production, which can effectively address the issues of being incapable of uniformly heating the wing blank before stamping, as well as applying lubricating oil to its outer surface during the feeding process.

To realize the above objective, the present invention employs the following technical solutions: a stamping device for UAV wing production includes a base, where a control box is fixedly mounted at a front end of the base; a support is fixedly connected to a rear end of the base; a hydraulic cylinder is fixedly mounted on an upper portion of the support; an upper die is fixedly connected to a lower end of the hydraulic cylinder and slidably connected to the support; a lower die is fixedly connected to an upper end of the base; a conveying and rotating assembly is arranged in an inner cavity of the base; and a hot oil brushing assembly is arranged at an upper right portion of the base.

Preferably, the conveying and rotating assembly includes sliding grooves disposed symmetrically at an upper end of the base along front and rear directions; a conveying mechanism is commonly arranged on inner surfaces of the two sliding grooves; clamping and rotating mechanisms are arranged symmetrically on an inner surface of the conveying mechanism along left and right directions; and an ejection mechanism is commonly arranged on an inner surface of the lower die and an inner surface of the base.

Preferably, the conveying mechanism includes a threaded rod rotatably connected to an inner surface of the base; a rotating rod I is rotatably connected to a front portion of the inner surface of the base; a transmission mechanism is commonly and fixedly connected to an outer surface of the rotating rod I and an outer surface of the threaded rod; a dual-shaft motor fixedly connected to a front end of the base is fixedly connected to a front end of the rotating rod I; a concave plate is threadedly connected to an outer surface of the threaded rod and is slidably connected to inner surfaces of the sliding grooves; and a rotating rod II is fixedly connected to a front output end of the dual-shaft motor via a coupling.

Preferably, the clamping and rotating mechanism includes a circular block rotatably connected to an inner surface of the concave plate; a concave block is fixedly connected to a front end of the circular block; a cylinder I fixedly connected to the concave plate is rotatably connected to an inner surface of the circular block; a piston rod I is slidably connected to an inner surface of the cylinder I; a spring I is sleeved on an outer surface of the piston rod I, with two ends of the spring I being fixedly connected to the inner surface of the cylinder I and a

piston on the piston rod I; a slider is rotatably connected to a lower portion of the outer surface of the piston rod I; a cylinder II is fixedly connected to an inner surface of the concave block; a piston fixing plate is slidably connected to an inner surface of the cylinder II; a connecting pipe penetrates through the inner surface of the cylinder I and extends to the inner surface of the cylinder II to be fixedly connected thereto, the connecting pipe being rotatably connected to the cylinder I; and guide grooves are symmetrically disposed on an upper end of the base along front and rear directions and slidably connected to the slider.

Preferably, a gear is fixedly connected to an outer surface of the circular block; racks are fixedly connected to an upper end of the base symmetrically along front and rear directions; and the gear is meshed with the racks.

Preferably, the ejection mechanism includes ejection rods which are symmetrically arranged along front and rear directions, penetrate through an inner surface of the lower die and extend to a lower portion of an inner surface of the base to be slidably connected thereto; a connecting plate is commonly and fixedly connected to lower ends of the two ejection rods; a roller is rotatably connected to an inner surface of the connecting plate; springs II are sleeved on outer surfaces of the two ejection rods, with two ends of each of the springs II being fixedly connected to an upper end of the connecting plate and the lower portion of the inner surface of the base; and a trapezoidal pressing plate is fixedly connected to a right end of the concave plate.

Preferably, the hot oil brushing assembly includes rectangular frames fixedly connected to an upper end of the base symmetrically in a vertical direction; a heating mechanism is arranged at a front end of the base; and an oil-brushing mechanism is commonly arranged on an upper end of the upper rectangular frame and an upper portion of an inner surface of the base.

Preferably, the heating mechanism includes a round-hole frame fixedly connected to a front end of the base; a round rod is rotatably connected to an inner surface of the round-hole frame; fan blades are fixedly connected to an outer surface of the round rod within an inner cavity of the round-hole frame; a heating box is fixedly mounted at the front end of the base; the heating box is connected to the inner surface of the round-hole frame via a pipeline; a blowing pipe penetrates through an upper end of the heating box and extends to be fixedly connected to an inner surface of the upper rectangular frame; and a pulley set is commonly and fixedly connected to an outer surface of the round rod and an outer surface of the rotating rod II.

Preferably, the oil-brushing mechanism includes two oil tanks fixedly connected to a lower

portion of an inner surface of the base and an upper end of the upper rectangular frame; a hollow block is fixedly connected to a rear end of each of the two oil tanks; fixing frames are fixedly connected to inner surfaces of the two rectangular frames symmetrically in a vertical direction; a sponge block is fixedly connected to an inner surface of each of the two fixing frames; a piston rod II is slidably connected to an inner surface of each of the two hollow blocks; a third spring is sleeved on an outer surface of each of the piston rods II, with two ends of each third spring being fixedly connected to a lower portion of the inner surface of the corresponding hollow block and a piston on the corresponding piston rod II; a connecting pipe penetrates through an upper portion of the inner surface of each hollow block and extends to be fixedly connected to an inner surface of the corresponding fixing frame; a check valve I is fixedly connected to a lower end of each connecting pipe; a check valve II is fixedly connected to and penetrates through an inner surface of each oil tank and extends to the inner surface of the corresponding hollow block; and two arc-surface pressing rods are fixedly connected to a left rear portion of the concave plate.

Compared to the related art, the present invention has the following beneficial effects.

1. In the present invention, by arranging a conveying mechanism, a clamping and rotating mechanism, and a heating mechanism, the wing rib blank can be automatically clamped and flipped during the stamping feeding process. During flipping, the blank is heated by hot air, which can remove dust from the outer surface of the wing rib blank and ensure uniform heating of the blank during the flipping operation. This uniform heating helps prevent localized overheating or undercooling of the entire material, thereby improving the material's plasticity and reducing the risk of deformation and cracks. Consequently, the stamping performance is optimized, forming accuracy is improved, material stress and brittleness are reduced, and stability and production efficiency during the stamping process are enhanced.

2. In the present invention, by arranging an oil-brushing mechanism, lubricating oil in the hollow blocks is squeezed out by the arc-surface pressing rods and applied onto the outer surface of the wing rib blank through the sponge blocks. This reduces friction during the stamping process, effectively decreasing the frictional force between the die and the blank, minimizing wear and temperature rise, and preventing excessive material wear or surface damage. Thereby, stamping accuracy is improved, the service life of the die is extended, forming defects are reduced, and overall production efficiency and product quality are enhanced.

3. In the present invention, by arranging an ejection mechanism, the two ejection rods can

eject the stamped wing rib from the lower die. This ensures smooth demolding of the stamped wing rib, preventing jamming or deformation. Simultaneously, production efficiency is improved, manual intervention is reduced, operational risks and labor intensity are lowered, and the consistency and stability of product quality are ensured, thereby enhancing the precision and production efficiency of the overall stamping operation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic structural diagram of an overall device according to the present invention.

FIG. 2 is a cross-sectional schematic structural diagram of the overall device according to the present invention.

FIG. 3 is a schematic structural diagram of a guide groove, a rack, and a sliding groove according to the present invention.

FIG. 4 is a cross-sectional schematic structural diagram of a conveying mechanism and a hot oil brushing assembly according to the present invention.

FIG. 5 is a cross-sectional schematic structural diagram of a cleaning mechanism according to the present invention.

FIG. 6 is a cross-sectional schematic structural diagram of a clamping and rotating mechanism according to the present invention.

FIG. 7 is a cross-sectional schematic structural diagram of an ejection mechanism according to the present invention.

FIG. 8 is a cross-sectional schematic structural diagram of a heating mechanism according to the present invention.

FIG. 9 is a cross-sectional schematic structural diagram of an oil-brushing mechanism according to the present invention.

FIG. 10 is an enlarged schematic structural diagram of area A in FIG. 9 according to the present invention.

Reference numerals and denotations thereof: 1-base; 2-support; 3-lower die; 4-upper die; 5-control box; 6-conveying and rotating assembly; 61-sliding groove; 62-conveying mechanism; 621-threaded rod; 622-rotating rod I; 623-dual-shaft motor; 624-transmission mechanism; 625-concave plate; 626-rotating rod II; 63-clamping and rotating mechanism; 631-circular block; 632-concave block; 633-cylinder I; 634-piston rod I; 635-spring I; 636-slider; 637-cylinder II;

638-piston fixing plate; 639-connecting pipe; 6310-guide groove; 6311-gear; 6312-rack; 65-ejection mechanism; 651-ejection rod; 652-connecting plate; 653-spring II; 654-roller; 655-trapezoidal pressing plate; 7-hot oil brushing assembly; 71-rectangular frame; 72-heating mechanism; 721-round-hole frame; 722-round rod; 723-pulley set; 724-fan blade; 725-heating box; 726-blowing pipe; 73-oil-brushing mechanism; 731-oil tank; 732-fixing frame; 733-sponge block; 734-piston rod II; 735-third spring; 736-hollow block; 737-connecting pipe; 738-check valve I; 739-check valve II; 7310-arc-surface pressing rod; and 8-hydraulic cylinder.

DETAILED DESCRIPTION

To make it easy to understand the technical means, creative features, objectives, and effects of the present invention, the present invention is further described below in combination with the detailed description.

Embodiment 1: As shown in FIGS. 1-2, a stamping device for UAV wing production includes a base 1, where a control box 5 is fixedly mounted at a front end of the base 1, and a support 2 is fixedly connected to a rear end of the base 1. A hydraulic cylinder 8 is fixedly mounted on an upper portion of the support 2. An upper die 4 is fixedly connected to a lower end of the hydraulic cylinder 8 and slidably connected to the support 2. A lower die 3 is fixedly connected to an upper end of the base 1. A conveying and rotating assembly 6 is arranged in an inner cavity of the base 1, and a hot oil brushing assembly 7 is arranged at an upper right portion of the base 1.

During implementation of this embodiment, the wing rib blank is placed in the conveying and rotating assembly 6. Subsequently, by operating the control box 5, the wing rib blank is automatically clamped while moving leftward. It is driven to be flipped. During the flipping process, it is heated by the hot oil brushing assembly 7. After heating, lubricating oil is applied to its upper and lower ends. When the wing rib blank is conveyed to a preset position by the conveying and rotating assembly 6, the hydraulic cylinder 8 drives the upper die 4 to move downwards, thereby performing a stamping operation on the wing rib blank placed on the lower die 3. After the stamping operation is completed, the conveying and rotating assembly 6 removes the excess scrap material, and the stamped rib is ejected from the lower die 3.

It is to be specifically noted that both the aforementioned control box 5 and the hydraulic cylinder 8 are mature technical means and equipment in the prior art, belonging to conventional technical designs. The internal structures, connection methods, and working principles are

therefore not elaborated upon in this solution.

Specifically, to achieve clamping and rotating of the UAV wing rib blank, reference is made to FIGS. 3-7. In this embodiment, the conveying and rotating assembly 6 includes sliding grooves 61 disposed symmetrically at an upper end of the base 1 along front and rear directions. A conveying mechanism 62 is commonly arranged on inner surfaces of the two sliding grooves 61. Clamping and rotating mechanisms 63 are arranged symmetrically on an inner surface of the conveying mechanism 62 along left and right directions. An ejection mechanism 65 is commonly arranged on an inner surface of the lower die 3 and an inner surface of the base 1.

Further, referring to FIGS. 4-5, in this embodiment, the conveying mechanism 62 includes a threaded rod 621 rotatably connected to an inner surface of the base 1. A rotating rod I 622 is rotatably connected to a front portion of the inner surface of the base 1. A transmission mechanism 624 is commonly and fixedly connected to an outer surface of the rotating rod I 622 and an outer surface of the threaded rod 621. A dual-shaft motor 623 fixedly connected to a front end of the base 1 is fixedly connected to a front end of the rotating rod I 622. A concave plate 625 is threadedly connected to an outer surface of the threaded rod 621 and is slidably connected to inner surfaces of the sliding grooves 61. A rotating rod II 626 is fixedly connected to a front output end of the dual-shaft motor 623 via a coupling.

Further, referring to FIGS. 3, 4, and 6, in this embodiment, the clamping and rotating mechanism 63 includes a circular block 631 rotatably connected to an inner surface of the concave plate 625. A concave block 632 is fixedly connected to a front end of the circular block 631. A cylinder I 633 fixedly connected to the concave plate 625 is rotatably connected to an inner surface of the circular block 631. A piston rod I 634 is slidably connected to an inner surface of the cylinder I 633. A spring I 635 is sleeved on an outer surface of the piston rod I 634, with two ends of the spring I 635 being fixedly connected to the inner surface of the cylinder I 633 and a piston on the piston rod I 634. A slider 636 is rotatably connected to a lower portion of the outer surface of the piston rod I 634. A cylinder II 637 is fixedly connected to an inner surface of the concave block 632. A piston fixing plate 638 is slidably connected to an inner surface of the cylinder II 637. A connecting pipe 639 penetrates through the inner surface of the cylinder I 633 and extends to the inner surface of the cylinder II 637 to be fixedly connected thereto, where the connecting pipe 639 is rotatably connected to the cylinder I 633. Guide grooves 6310 are symmetrically disposed on an upper end of the base 1 along front and rear

directions and are slidably connected to the slider 636.

During implementation, the wing rib blank is placed between the two concave blocks 632. Subsequently, the rear output end of the dual-shaft motor 623 is activated to drive the rotating rod I 622 to rotate via the coupling. Under the action of the transmission mechanism 624, the threaded rod 621 rotates. Since the concave plate 625 is threadedly connected to the threaded rod 621, the concave plate 625 moves leftward, thereby driving the wing rib blank to move.

Furthermore, during this movement, as the two guide grooves 6310 are convex-shaped, the slider 636 on the piston rod I 634 slides along the inner surfaces of the guide grooves 6310, allowing the piston rod I 634 to slide within the inner surface of the cylinder I 633. Consequently, the piston on the piston rod I 634 presses the hydraulic oil in the cylinder I 633, forcing it through the connecting pipe 639 into the cylinder II 637. This, in turn, pushes the piston fixing plate 638 to move downward, thereby securing the wing rib blank placed on the concave blocks 632. This enables automatic fixation of the wing rib blank during the feeding process. The automatic fixing operation improves the precision and stability of the stamping process, reduces manual intervention, ensures the blank does not shift during stamping, and enhances production efficiency and finished product quality.

The inner cavity of the aforementioned cylinder I 633 is filled with hydraulic oil.

The aforementioned transmission mechanism 624 includes two bevel gears.

Further, referring to FIGS. 3, 4, and 6, in this embodiment, a gear 6311 is fixedly connected to an outer surface of the circular block 631. Racks 6312 are fixedly connected to an upper end of the base 1 symmetrically along front and rear directions. The gear 6311 is meshed with the racks 6312.

During implementation, when the gear 6311 on the circular block 631 meshes with the rack 6312 on the base 1, and since the connecting pipe 639 is rotatably connected to the cylinder I 633, the gear 6311 drives the circular block 631 to rotate within the inner surface of the concave plate 625, thereby causing the secured wing rib blank to flip.

After the aforementioned gear 6311 and rack 6312 disengage, the wing rib blank remains parallel to the base 1, and the rotation between the circular block 631 and the concave plate 625 possesses a certain degree of resistance.

Further, referring to FIGS. 4, 5, and 7, in this embodiment, the ejection mechanism 65 includes ejection rods 651 which are symmetrically arranged along front and rear directions,

penetrate through an inner surface of the lower die 3 and extend to a lower portion of an inner surface of the base 1 to be slidably connected thereto. A connecting plate 652 is commonly and fixedly connected to lower ends of the two ejection rods 651. A roller 654 is rotatably connected to an inner surface of the connecting plate 652. Springs II 653 are sleeved on outer surfaces of the two ejection rods 651, with two ends of each of the springs II 653 being fixedly connected to an upper end of the connecting plate 652 and the lower portion of the inner surface of the base 1. A trapezoidal pressing plate 655 is fixedly connected to a right end of the concave plate 625.

As can be seen from the above, after the stamping of the wing rib blank is completed, the conveying mechanism 62 and the clamping and rotating mechanism 63 will continue to drive the scrap material leftward. During this movement, the trapezoidal pressing plate 655 at the rear end of the concave plate 625 contacts the outer surface of the roller 654. The trapezoidal pressing plate 655 gradually presses against the roller 654, pushing the two ejection rods 651 upward and compressing the springs II 653. Consequently, the two ejection rods 651 eject the stamped wing rib from the lower die 3. This ensures smooth demolding of the stamped wing rib, preventing jamming or deformation. Simultaneously, production efficiency is improved, manual intervention is reduced, operational risks and labor intensity are lowered, and the consistency and stability of product quality are ensured, thereby enhancing the precision and production efficiency of the overall stamping operation.

Embodiment 2: the present embodiment adds, on the basis of Embodiment 1, a hot oil brushing assembly 7 for heating and oil-brushing the blank before stamping, thereby achieving the objective of heating and oil-brushing the blank prior to stamping.

Specifically, to heat and oil-brush the blank before stamping, reference is made to FIGS. 8, 4, 5, 8, 9, and 10. In this embodiment, the hot oil brushing assembly 7 includes rectangular frames 71 fixedly connected to an upper end of the base 1 symmetrically in a vertical direction. A heating mechanism 72 is arranged at a front end of the base 1. An oil-brushing mechanism 73 is commonly arranged on an upper end of the upper rectangular frame 71 and an upper portion of an inner surface of the base 1.

Further, referring to FIGS. 4 and 8, in this embodiment, the heating mechanism 72 includes a round-hole frame 721 fixedly connected to a front end of the base 1. A round rod 722 is rotatably connected to an inner surface of the round-hole frame 721. Fan blades 724 are fixedly connected to an outer surface of the round rod 722 within an inner cavity of the round-hole frame

721. A heating box 725 is fixedly mounted at the front end of the base 1. The heating box 725 is connected to the inner surface of the round-hole frame 721 via a pipeline. A blowing pipe 726 penetrates through an upper end of the heating box 725 and extends to be fixedly connected to an inner surface of the upper rectangular frame 71. A pulley set 723 is commonly and fixedly connected to an outer surface of the round rod 722 and an outer surface of the rotating rod II 626.

During implementation, as the wing rib blank is being conveyed and flipped during the feeding process, the front output end of the dual-shaft motor 623 is activated to drive the rotating rod II 626 to rotate via the coupling. Under the transmission action of the pulley set 723, the fan blades 724 on the round rod 722 are driven to rotate. The rotation of the fan blades 724 draws air into the interior of the round-hole frame 721, which then enters the heating box 725 via a pipeline. The air is heated by the heating box 725. The heated air then enters the two rectangular frames 71 through the blowing pipe 726. This process firstly cleans dust from the outer surface of the wing rib blank. Simultaneously, it heats the flipping wing rib blank, ensuring uniform heating during the flipping operation. This uniform heating helps prevent localized overheating or undercooling of the entire material, thereby improving the material's plasticity, reducing the risk of deformation and cracks, optimizing stamping performance, improving forming accuracy, reducing material stress and brittleness, and enhancing stability and production efficiency during the stamping process.

The aforementioned heating box 725 is a mature heating technical means and equipment in the prior art. In this solution, the function of heating air is utilized, and its internal structure, connection methods, and working principles are not elaborated upon.

The aforementioned dual-shaft motor 623 is a mature driving technical means and equipment in the prior art. In this solution, it is utilized for the independent rotation capability of the couplings on both sides and its ability to stop after rotating a preset number of turns. Its internal structure, connection methods, and working principles are not elaborated upon.

Further, referring to FIGS. 4, 5, 9, and 10, in this embodiment, the oil-brushing mechanism 73 includes two oil tanks 731 fixedly connected to a lower portion of an inner surface of the base 1 and an upper end of the upper rectangular frame 71. A hollow block 736 is fixedly connected to a rear end of each of the two oil tanks 731. Fixing frames 732 are fixedly connected to inner surfaces of the two rectangular frames 71 symmetrically in a vertical direction. A sponge block 733 is fixedly connected to an inner surface of each of the two fixing frames 732. A piston rod II

734 is slidably connected to an inner surface of each of the two hollow blocks 736. A third spring 735 is sleeved on an outer surface of each of the piston rods II 734, with two ends of each third spring 735 being fixedly connected to a lower portion of the inner surface of the corresponding hollow block 736 and a piston on the corresponding piston rod II 734. A connecting pipe 737 penetrates through an upper portion of the inner surface of each hollow block 736 and extends to be fixedly connected to an inner surface of the corresponding fixing frame 732. A check valve I 738 is fixedly connected to a lower end of each connecting pipe 737. A check valve II 739 is fixedly connected to and penetrates through an inner surface of each oil tank 731 and extends to the inner surface of the corresponding hollow block 736. Two arc-surface pressing rods 7310 are fixedly connected to a left rear portion of the concave plate 625.

During implementation, as the concave plate 625 moves leftward, it drives the two arc-surface pressing rods 7310 to move accordingly. These rods press against the piston rods II 734, compressing the third springs 735. This action causes the piston rods II 734 to squeeze the lubricating oil within the inner cavities of the hollow blocks 736, forcing it through the check valves I 738 into the connecting pipes 737 and subsequently into the sponge blocks 733. When the piston rods II 734 are no longer being pressed, the compressive reaction force of the third springs 735 draws lubricating oil from the oil tanks 731 through the check valves II 739 into the inner cavities of the hollow blocks 736. This process applies lubricating oil to the upper and lower ends of the wing rib blank. This lubrication reduces friction during the stamping process, effectively decreasing the frictional force between the die and the blank, minimizing wear and temperature rise, and preventing excessive material wear or surface damage. Thereby, stamping accuracy is improved, the service life of the die is extended, forming defects are reduced, and overall production efficiency and product quality are enhanced.

The aforementioned check valve I 738 and check valve II 739 are mature unidirectional control technical means and equipment in the prior art. In this solution, the function of controlling the flow direction of liquid is utilized, and the internal structures and working principles are not elaborated upon.

An operating process is as follows. During operation, the conveying mechanism 62 and the clamping and rotating mechanism 63 automatically perform clamping and fixing of the wing rib blank during the feeding process. During conveyance, they drive the wing rib blank to flip. During the flipping operation, the heating mechanism 72 uniformly heats the blank and can clean

dust adhering to its outer surface. Subsequently, during conveyance, lubricating oil is automatically applied to the outer surface of the wing rib blank. After stamping is completed, the ejection mechanism 65 ejects the formed wing rib from the inner cavity of the lower die 3.

The fundamental principles, main features, and advantages of the present invention have been shown and described above. Those skilled in the art shall understand that the present invention is not limited to the foregoing embodiments. The embodiments and the description are provided merely to illustrate the principles of the present invention. Without departing from the spirit and scope of the present invention, various changes and modifications may be made thereto, all of which fall within the scope of the present invention as claimed. The claimed scope of the present invention is defined by the appended claims and equivalents thereof.