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Reformation of motorized spindle based on Composites Machining Center

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Abstract. This text passes according to the design of the tool machine reformation spindle, to five axis bridge type compound material machining center motorized spindle design reformation, and design to transfer board, finally success apply to engineering.

Introduction

Advanced compound material is since 1976, through the development of more than 30 years, already extensively applied in the realms, such as aviation and aerospace etc. The special structure and characteristic of the compound material put forward a higher request towards processing an equipments.(1)Requested to turn generally soon when beehive processed an equipments to install the high performance motorized spindle above in the 24000 rpm/min, for the convenience of in slice to pare;(2)Install to gather oil to defend liquid device , Should install to absorb the dust system for avoiding the oil drop the pollution work piece(3) tool machine with slice the scraps collections to equip, promise can actually hour collect 90% availably to reunite material to slice the scraps and dust above, prevent from an industrial pollution.

Technique condition

Give or get an electric shock a spindle to used for the aluminum metal alloy to process an equipments mostly currently in, used for the motorized spindle that the compound material process because of leaking the oil reason to take place quality trouble easily now. Existing compound the material process an equipments in, 80% equipment break down the reason concentration to leak the oil and damage in the spindle up, and cause to process of the spare parts discard because of the oil liquid pollution, how resolve an electricity a spindle and leak the oil problem and is reply the important hard nut to crack that the material processes research in the realm whole world.

Carry on analysis towards leaking the oil phenomenon, the detection motorized spindle existence spindle machine structure blemish with loosen to pull the design blemish that the tool liquid press, seal completely a turn in the meantime is not standard piece, at on the market also hard find out substitute, increase the difficulty for maintain. Diagram 1 of the stalk saw diagram to display clearly to loosen to pull the tool structure design

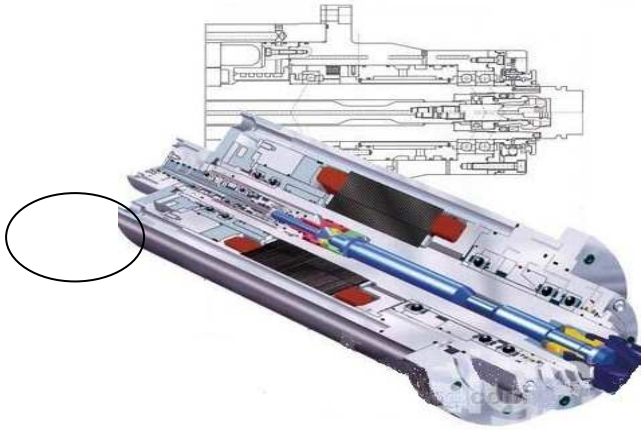

Fig.1 A type of spindle

Reform technique

Connect board technique. Study cold discharge of the spindle water with pick up a people the relation of conversion board bore path, design to connect a people's bore suitable; Attain reasonable illegitimate profit separation, avoid reveal, design to seal completely stronger structure of sex; Carry on setting up a mold towards revolving the part space, carry on the cloth tube design to special part, make the tool machine revolve to avoid piping in the process to squeeze to transform mutually. Combine five axis bridge type compound material machining center on the scene process the environment assurance technique route as follows:

The water power radius R definition for lead to flow the specific value that the cross section area A and moist week grow L. have:

$$R=A / L \tag{1}$$

In the type: Once the A cool off the area (m^2) of the horizontal piece of the piping noodles, also calling to flow cross section area;

L-the moist week is long (m), meaning to flow the cross section upper-class body and the solid wall noodles boundary for contiguous week. The ream non- circle the water power diameter of the tube with take care of together of the water power diameter equal, then have:

$$d=4R_1=\frac{2ab}{(a+b)} \tag{2}$$

In the type: The type piping horizontal piece the equivalent diameter (m)

Pass the pip analysis, the standard liquid that takes care of road to connect a people's acceptance presses pressure small in 130 bars, spindle system the pressure of the cold water is small in the 10 bars, the discharge is small in the 11L/Min and big in 5L/Min, the pressure of the air pressure is small in the 7 bars.

Among them, 19 holes and tool machine of the spindle forepart method dish put 19 holes of the head in order to match with hole, need a precise fixed position to promise the liquid press, deliver of air pressure. in order to get each accurate position of bore, dismantle owner's stalk Flange bottom, carry on diagraph, conduct and actions makes to order the basis of the spindle.

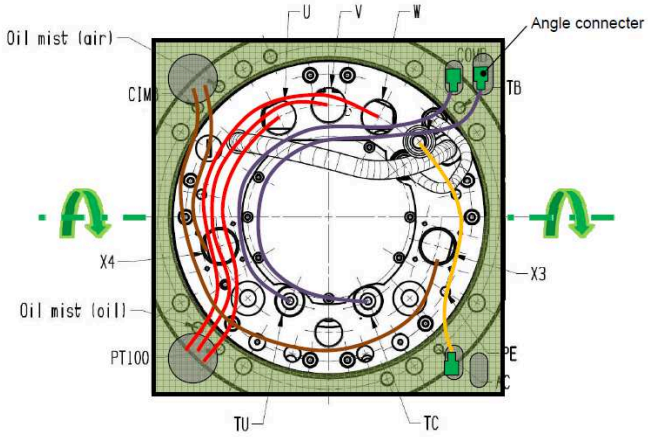

Fig.2 Flange

The spindle coda has three liquids to press a tube to deal with contact(loose tool pipeline, tight tool pipeline, cool off the water reflux tube), need to put the match bore of the head to connect with each other with tool machine, can't carry out a direct match here, have to re- design to transfer board, put tool machine the match bore of the head conversion for in general use deal with contact, then can carry out the conjunction of the spindle. Transfers the conjunction that the board still needs to carry out to carry a cover in the meantime. Pass the CATIA establishment model, process to transfer board.

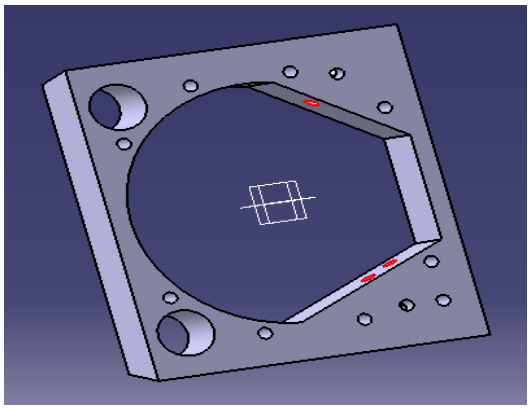

Fig.3 Transfer board.

Temperature compensates technique. All of the formulas that used for computing convection to change hot coefficient is according to experiment but get of experience the connection type, therefore, while use formula, the selection of the parameter wants strictly an usage condition of obey the formula with apply scope.

(1) Layer inside the tube flows to change heat (R^e<2300)

$$Nu_f = 1.86(\mathrm{Re}_f \mathrm{Pr}_f \frac{d}{l})^{1/3} (\frac{\mu_r}{\mu_w}) \tag{3}$$

(2) Transfer the convection in area changes heat (2300< R^e <10^4)

$$Nu_f = 0.012(\mathrm{Re}_f^{0.87} - 280)\mathrm{Pr}_f^{0.4} (\mathrm{Pr}_f \, l \, \mathrm{Pr}_u)^{0.11} \tag{4}$$

(3) Swift flow inside the tube changes heat (R^e ＞10^4)

$$Nu_f = 0.027\mathrm{Re}_f^{0.8} \mathrm{Rr}_f^{1/3} (\mu_f l \mu_w)^{0.14} \tag{5}$$

The high-speed spindle is very high to the request that keeps the work temperature, if don't control in a scope, the spindle will appear various abnormality, then producing breakdown lightly, heavy then destroy by fire a spindle. The high-speed spindle mainly takes calories through 4 kinds of paths, including current of air, oil fog and making the cold water and surface contact. Among them, the current of air, the oil fog and the surface contact take of calories less, and the surface contact still is influence by the environment, so high-speed spindle' making a cold method most importantly is to pass to make a cold water to carry on circulation in the spindle exterior, taking so of the calories need to carry on conduction through more component, but the new spindle seal inner part circularly to pack to settle son interiorly, leaving a hot source nearer than owner's stalk have to be many, make cold result better.

Fig.4 Spindle

Owner's stalk with new the spindle uses the bearings temperature to spread the feeling machine, but original motorized spindle at 20 ℃. electric resistance is 109 Ω, but new spindle at 20 degrees electric resistance is 117 Ω. These electric resistance difference may be because the circuit dissimilarity, connect the line appearance inconformity to cause, so need to carry on a processing in the way of accommodation. Because actual the temperature error margin at 2-3 ℃. in can satisfy to process a need, so pass the similar appearance next two pedestal homology tool

machine to turn to descend to carry on the temperature contrast experiment soon in the different spindle, make sure always more normal temperature of the new spindle above 10℃. The bearings temperature PLC drawn up to correspond, compensate temperature to lose really.

Accuracy compensates technique

The integration tries RTCP of the piece to moves a number to control the tool machine accuracy examination according to "S part", move the dynamic state accuracy examination according to the RTCP and excellent turn and supervise and control according to the sport of axis stalk dynamic state characteristic examination and excellent turn etc. several key techniques, the formation used for number to control tool machine to move the dynamic state accuracy examination and excellent turn of whole solution

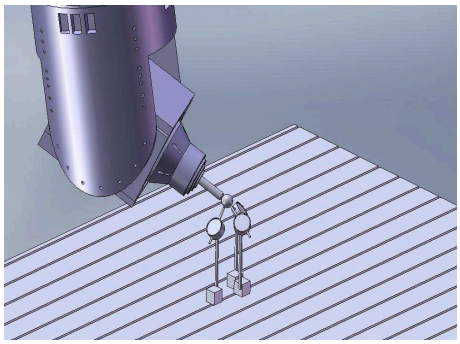

Fig.5 RTCP measurement

The NC the RTCP function of the tool machine to round point of a tool to order to move with it of special sport form, have the sport appearance examination convenience, can include three axis to move, RTCP move etc. advantage, so in keeping with surround this function development to correspond of sit and mark the stalk move the dynamic state accuracy examination method, and guide the dynamic state accuracy of the tool machine on these grounds excellent turn.

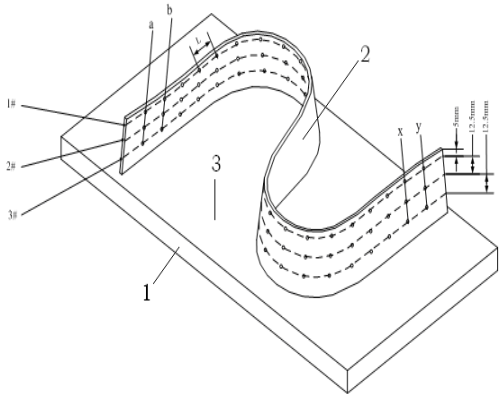

Fig.6 S part

"S" part a reason analysis that can settle sex instruction tool machine to process an error margin, can't get tool machine each accurate value that RTCP to move an error margin, still needing for this can accurate measure each point to move the dynamic state error margin is also the instruction is excellent to turn to adjust of method. The dynamic state accuracy examination and error margin trace to origins the technique research of the aspect, the theories level has to be built up the tool machine kinetics model, the dynamics model and related error margin to deliver model first; Tool and measure the method choice aspect, have to consider in general use fast.

Summary

Operate a personnel to need to enter to process whether the area observation spare parts is pollute or not because of appearing a spindle to leak the oil problem while process large beehive spare parts before reform. Resolved to leak an oil problem after reform. Can satisfy the production need that" zero interventions" of foam and beehive spare parts process. The accuracy examination attains a factory standard, succeeding to apply to practice in the production medium.

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