

INTELLIGENT CLAMPING FIXTURES FOR BOX SHAPED WORKPIECES

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Abstract: Today manufacturing processes are characterized as small batch production. Effective small batch production is possible only by using automation in all possible tasks of production. Very important task of automated small batch production is a workpiece clamping. The automated clamping tasks for this type of production contains several particular tasks to solving. One of them is a task of creating some intelligence in automated clamping device.

Key words: manufacturing system, intelligent device, automated manufacturing

1. INTRODUCTION

The clamping fixture provide clamping of workpiece on machine desk, so as the workpiece have the right position toward tool. This position must be retain in machining time too.

Fixture using increasing the production quality, the productivity and decreasing the production costs. In some cases are fixture using necessary. The fixture design are dependent on the batches of production. In small batches we use the fixtures designed from modular system and in large batches we can use the dedicated fixtures.

The clamping fixture providing these basic functions:

- workpiece positioning on the desk of machine,
- to prevent of workpiece deformation when cutting and clamping forces are acting,
- tool support (in some cases).

These functions are provided by positioning, clamping and supporting elements (active elements) of fixture. These elements can be placed on standalone unit or on some units or can be mounted to machine or some its part.

The aim of each technological process is produce a product by required quality. Required quality product realization in automated technological system (ATS) is different as in conventional technological system. This difference are caused human acting elimination in production processes. Automated technological system must ensure required product quality by theirs properties and parameters without human action. Consequently all subsystems automated technological systems are participated to provide for required quality with different but function dependent deals. For automated technological systems production quality

requirements assurance are needed correct decomposition functions between individual subsystems ATS, their time and position synchronisation. In this process are needed respect dynamic shows and compatibility bilateral inputs and outputs of technological process in ATS.

2. INTELLIGENT CLAMPING FIXTURE IN GENERAL

The majority of actual production are small or middle batch character. Thence, using of flexible production systems for these types of production has a lot of advantages. The flexible production systems must have a flexible clamping fixtures too. This new generation fixture devices different from classical fixtures not only by design but also by its properties.

In standard production are mechanical peripheries (for example fixtures) controlled and monitored by operators. In automated production must these mechanical peripheries working in automated mode too. It means, that they must have not only own driving mechanism (hydraulic, pneumatic, electrical), but must have control and monitoring units too. The examples of pneumatically controlled clamping mechanism is at Fig. 1.



Fig. 1 *Examples of pneumatically controlled clamping mechanism*

In time of working cycle these devices working automatically, without operator intervention and cooperate with other devices of production system.

During a automated work cycle are control and monitoring execute by sensors. The control based on sensors and controlled driving mechanism are base conditions for intelligent clamping fixture realize.

These intelligent clamping fixtures apart from the base functions provide same “intelligent” functions too:

- control of forces and torques acting to workpiece,
- monitoring of clamping operations and particular elements of fixture by sensors,
- other purpose oriented functions as clamping jaw change, or change of industrial robots end effectors .

The aims of force and torque controlling are increasing of clamping operations reliability, decrease of workpiece deformation and decrease of workpiece surface damage possibility.

The clamping forces are proportional to pressure in pneumatic or hydraulic cylinder. This means, that we can monitor the clamping forces by monitoring of pressure in cylinder. For pressure monitoring are used pressure sensors on base of tenzometers. For exact measure of clamping forces we can use force sensors build in clamping jaws.

The monitoring of clamping operations and particular elements of fixture enable the continuous diagnostic of clamping system. In base of this diagnostics can predict the possible future damages of fixture and we can disposal them before come dropout in production, or ensue the bigger damage on the fixture system, tools or workpiece.

These clamping fixtures can be used in various field of small batch production:

- clamping for NC, CNC machines,
- clamping for robotized production,
- clamping for measure systems,
- clamping for special automated operations.

3. SOLUTION OF INTELLIGENT CLAMPING FIXTURE

At our department is under realization the intelligent clamping fixture for flexible manufacturing cell. The basic condition to this clamping fixture is fellows:

- clamped workpiece has dimensions up to 60 mm,
- this fixture must be operated pneumatically (simply to change the clamping force by pressure),
- possibility of clamping jigs change,
- this fixture must give information to control system about:
 - air pressure,
 - position of clamping jigs (open or closed),
 - workpiece occurrence in clamping space,
 - clamping jig occurrence at jig holder,

When we will equip the clamping fixture by sensors, we achieve to capability collaboration between clamping fixture and flexible manufacturing cell.

As a base of our intelligent clamping fixture we chose the clamping mechanism MHF2 from FESTO. The advantages of this type of clamping mechanism are: simplicity, safety, reliability, appropriate clamping dimensions and forces and high durability.

The moving of clamping jigs holder are solved by pneumatic cylinders. synchronization of this moving are realized by gears. Position of clamping jigs can be detected by magnetics sensors on side of fixture body.

The position of clamping jig holder are detected by two magnetic sensors on side of fixture body.

The CAD model of our intelligent clamping fixture is shown in Fig. 2.

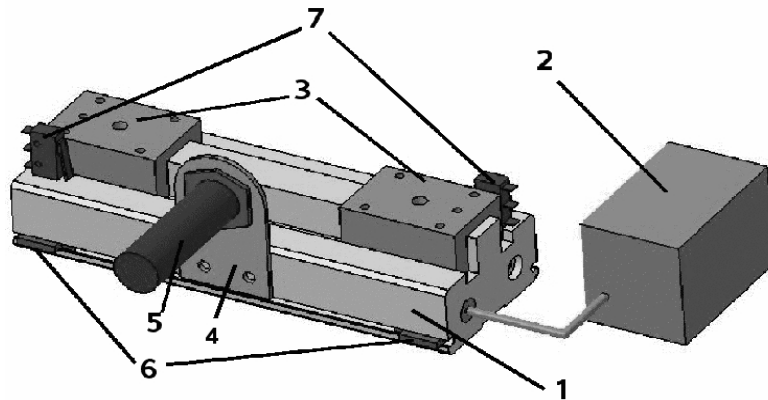


Fig. 2 CAD model of our intelligent clamping fixture

1- body of clamping fixture, 2 – pressure regulator, 3 – clamping jig holders, 4 – sensor holder, 5 – optical sensor for workpiece detection, 6 – magnetic sensors for clamping jig position detection, 7 – micro switches for clamping jig detection

4. CONCLUSION

Use of intelligent fixtures helps increase reliability of manufacturing operations. Production with intelligent fixtures are more flexible. These fixtures are more expensive and more complex as classical fixtures, because has own automated clamping, positioning, control and monitoring units.

The intelligent devices helps prevent the production disorders in automated production systems.

Application of intelligent fixtures eliminate the hard manual works. Also can save manpowers and increase the productivity.

The aim advantage of intelligent fixture using are their capability react to production program exchange. Adaptability of these systems are base of higher generation of automation.

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