

AUTOMATION COMPONENTS USED FOR ADAPTIVE CONTROL – SCA FOR THE FCA – 810 M CIRCULAR SAWS FOR MATERIALS' SAWING THROUGH CUTTING

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Abstract: The principle of adaptive control solution on materials' sawing through cutting by the FCA – 810 M saw consists in measuring the true power of electric engine of disk blade, and its comparison with the referential true power by the intermediate of a referential (computer). The electric signal outputted following the computer processing is being used for cutting feed adjustment to prevent exceeding the maximum bearing load per blade tooth.

The main monitoring components of active control system are discussed

1. GENERAL CONSIDERATIONS

Through the adaptive command of a machine-tool we understand the automatic accomplishment in closed circuit of the parameters of the splinting regime based on:

- A prior agreed strategy within an algorithm
- Current data received from the splinting process by measuring characteristic measures of the respective process

The adaptive command presents the following advantages:

- Obtains the parameters of the splinting regime when this cannot be done by calculation
- Increases the accuracy by maintaining constant the elastic distortions of STE
- Protects the tool and the machine-tool from over-charges
- Obtains the best splinting regimes depending on the performance criteria chosen
- Eliminates the influence of disturbing factors

In compliance to [3] and [4], the principle of the solution of adaptive command to discharge through splinting of materials with the circular saw type FCA-810M [1] and [4], production SC MES SA Suceava (figure 1) is represented by measuring the active power of the electric engine [5] to move the web-disk and its comparison to an active power of reference, within an element of comparison (computer).

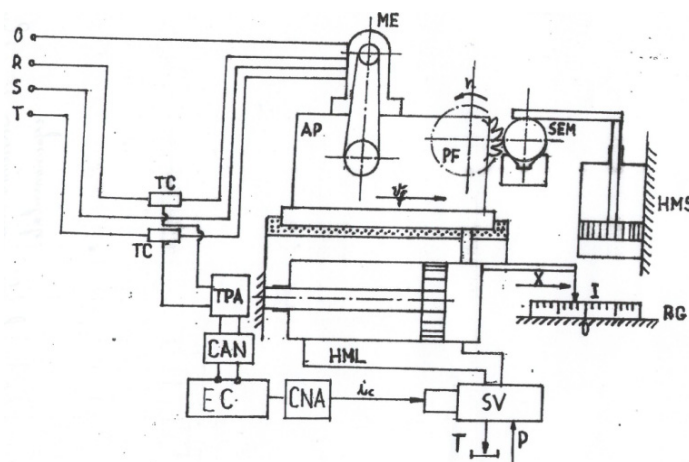


Figure 1: The scheme of experimental installation [1]

The electric signal resulted following the processing (comparison) from the computer; it is used in order to adjust the advance speed of the tool-holder slide, so that it does not exceed the maximum contact pressure on a tooth.

The main components of automation of the adaptive command system [7] are as follows:

- Transducer for measurement of the active power
- Incremental transducer for linear displacement
- Servo-valve for automatic adjustment of the advancement speed
- Converter which transforms continuous voltage in digital or incremental signals
- Converter which transforms the digital signals in continuous voltage.

2. BRIEF PRESENTATION OF THE AUTOMATION COMPONENTS

2.1. CONVERTERS

The converters are electronic devices supplying at exit continuous power signals, in linear function of the value of entrance value.

The adaptive command is based on the data received from the process of splintering. Also, the issue of using adequate converters is of maximum importance.

The majority of parameters which have to be determined represent non-electric values: forces, stress moments, powers. These will be converted into corresponding electric signals.

2.1.1. CONVERTER FOR THE MEASUREMENT OF ACTIVE POWER TPA

In compliance to [1], it measures the active power at the place of contact between the hand-tool (web-disk) and the semi finished chipping.

TPA is analogical equipment. It supplies a continuous tension which cannot be processed by the element of comparison EC. As such, between TPA and EC a numerical analogical converter CAN is positioned, transforming the continuous voltage into digital or incremental signs.

For the measurement of active power through the transformation of tension or power, I have chosen the converter type 2TPT-79 from the range of products of IAEM Timisoara.

2.1.2. THE INCREMENTAL CONVERTER OF LINEAR DISPLACEMENT "I"

The entrance X of the web disk into the semi finished chipper is measured with the comparing rule RG.

The voltage from this converter is an entrance value into the computer and fulfils the following functions:

- Defines the position of zero, that is, the position of contact between the web disk and the semi finished chipper
 - Defines the point of passing from the displacement with V_{max} to V_{min} ($X = -2 \div 3mm$)
 - Measures the current value of the entrance X at the entrance of the web disk into the semi finished chipper, transmitting the corresponding signal to the comparison element EC
- This converter is an incremental one. As such, the exit signals are directly transmitted to the computer which has the capacity to process them without being transformed.

In the adaptive command system SCA, due to the fact that the element of comparison - the computer works only with digital signals, it is necessary that at the entrance and exit to use converters so that, at the end, SV can be ordered. Thus:

- Analogical-numerical converter - CAN, transforms the continuous voltage into digital signals
- Analogical-numerical converter - CNA, transforms the digital signals into continuous voltage

This voltage serves to command the servo-valve which will modify the advance speed of the tool-holder slide so that the maximum pressure on the teeth of web disk should not be exceeded.

2.2. ELEMENT OF COMPARISON (COMPUTER)

The element of comparison EC used is a computer type PC (Personal Computer) because during the functioning of SCA, large quantities of data cannot be used and a special rapidity cannot be pretended.

The computer is, in essence, an assembly of components with specific functioning, having as purpose the processing of data.

The computer is, in the same time, a programmable machine with two features:

- Responds in a well-defined manner to a set of instructions well-defined
- Accomplishes a sequence of instructions registered (programme)

In the system of adaptive command – SCA, has the role to make comparisons between the active power consumed by the electric engine of activating of the web-disk and the active power from the computer.

The computer does not work with a continuous voltage, but with digital signals (incremental). As such:

- At the entrance: we have digital signals given by the converter CAN
- At the exit: we have an incremental sign. As such, it passes through the converter CNA which transforms the digital signals into continuous voltage, serving at the command of the servo-valve.

The computer determines at any moment of entering the web-disk into the semi finished chipped the difference between the two pressures, obtaining at the exit “ $\pm\Delta U$ ” incremental. In connection to the signal and the value of this voltage, it is modified automatically (through the servo-valve) the speed of advance so that the equality between the two powers is maintained.

2.3. SERVO-VALVE

The basic scheme of the servo-valve is presented in figure 2.

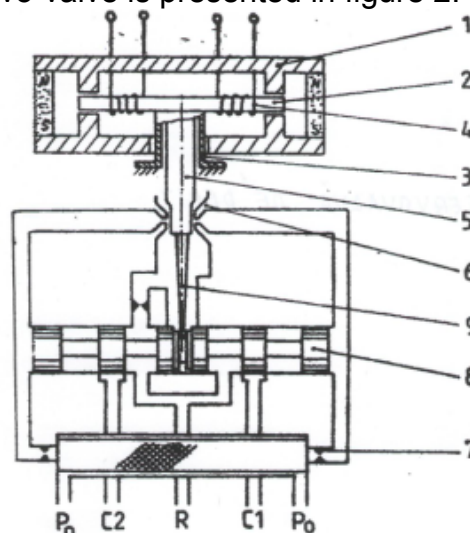


Figure 2: The basic scheme of the hydraulic servo-valve [4]

In compliance to 2, at the converter of power the voltage “ $\pm\Delta U$ ” is applied, which is the result of comparison of the element of comparison EC between the power of reference P_{ref} and the active power P_a consumed at the entrance of the hand-tool (web-disk) into the semi finished chipper.

The voltage " $\pm\Delta U$ " is applied in a different manner. As a consequence, at the coil from the left, the voltage increases and at the other one it decreases, in connection to the polarity of voltage. It is thus created an electro-motor force which displaces to the right the rigid lever 5 with the lever of the electro-magnet.

It is thus closed one of the two nozzles 6 fact which determines the increase of pressure on the circuit of command of the distributor.

At the moment of displacement of reinforcement to the right, the bar 5 closes the nozzle 6 from the right, increases the pressure on the pipe Po (from the right) until the nozzle. From this reason, the pressure pushes on the frontal surface of the distributor 8 from the right. As follows, the drawer 8 is displaced to the left.

As the command voltage " $\pm\Delta U$ " is higher, the displacement speed of the drawer 8 is higher.

3. CONCLUSIONS

The experimental facilities are of personal design and conception and they are based on the FCA-810M circular saws (internal manufacturing). Through their operating, they protect both the tool and the machine against overloading, thus tuning the feed-speed.

The designed adaptive control system – ACS – ensures the maximum conversion capacity for circular saws without jeopardising the safety of gear-teeth of the band-saws by protecting them against breaking.

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