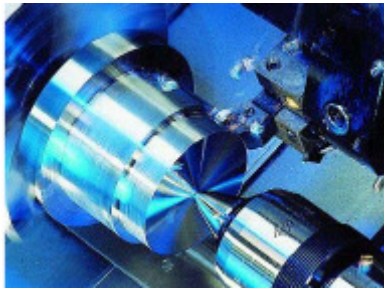


Reconstruction and modernization of metal cutting machines



Metal-working machine tool holding is out of repair at the most Kazakhstan enterprises, especially power equipments and control system. Because of decline in production machines are not used for a long time and a lot of them are not completed. Nowadays enterprises restart the production, increase made production volume and therefore it is required machine tool holding innovation and reconstruction.

Beginning from the end of 1980-s of last century machine tool holding isn't innovated, having equipment at the plants are in operation more than 30 years. A lot of machines, especially for heavy machining, have regulated drives according to variable-voltage system with control circuit on the magnetic or rotary amplifiers and sometimes with amplifiers on the electronic valves. These control systems are bulky and they are not reliable, their repair and service are difficult. Available rotating machines (of RC-oscillator and drive motor) increase occupied working areas by equipment, make a needless noise, it is observed runout of machine mechanical portions. During the equipment reconstruction and reconditioning it's economically and technically better to change existent control systems to modern, developed based on recent development in the electronics and microprocessor technology sphere. Nowadays suggested equipment for these goals is more reliable and more productive. Its using during machine tool holding reconstruction and reconditioning allows reaching reliable work, to bring up machine operating characteristics to the modern level of technical development in the machine tool industry area.

EQUIPMENT, SUGGESTED FOR MACHINES RECONSTRUCTION

Mini-controllers and logical modules allow changing bulky and non-reliable relay control circuits to the modern devices with microtechnology.

Wide spread occurrence for these goals has got as follows:

- controllers **OCS-100** and **OCS-200** from the GE Fanuc firm
- **SIMATIC C7-621** from the Siemens firm



These controllers with small sizes and low price combine with the processor and operator's panel at the same time. Such controllers are called "two-in-one". These controllers are installed in pulpits without any problems, and having character display they permit to get information about machine working modes, device condition diagnostic operation. Controller front panels have keyboard unit, it allows entering required parameters of machine work (cutting velocity, speeds of delivery, number of passes, working surface configuration etc). By means of these controllers it is possible to realize accurate positioning system, as they replace such devices as "Razmer M" and similar one successfully. In some cases it is possible to implement the simplest NC system. Despite its small size its software allows implementing all kinds of logical conversions, also carrying out mathematical operations under continuous signal in the digital form.



Using controller it is excluded from circuit as follows:

- electromechanical relay
- amplifiers
- Signal synchronizer and conversion units

According their functionalities, systems with controllers have more capacities, than circuits with mechanical relay. It is appeared the capacity to expand interlocking connections, to control machine operator's actions excluding and preventing emergency situations (human factor).

It is not only simple change of one type equipment to another one but also it's totally new quality of control system.

Controllers using allows reducing volume of required cable production for repeated communication, i.e. control signals are transferred through communication lines consisting of one or two wire pairs.

Pulpit design changes for the better:

- Control elements (buttons, keys, pot resistors, switchers) are reduced
- Structurally control elements are more easier than ones at relay control circuits.
- Machine control becomes more ergonomic

On the basis of controllers we have carried out modernization of the following:

- **Machine for rolls polishing at rolling mills.** Its control block is made on the controller **OCS 100** and provides surface forming of the roll in preset curve.
- **Cross cutting line of coil** metal to sheets of specified length. The controller operates speed modes, measured cut, it keeps production records and forms metal packs with preset parameters.
- **Curing compression apparatus.** Control system on **OCS 100** operates curing cycles of conveyer belt, providing programmable technological process, controls pressure and temperature, operates elements of mnemocircuit and mechanical aids.
- **Test desk.** Test desk is assigned for testing and running of gear reducer of passenger stock generators. System provides constrained time speed and load performances of test program. Some different programs are saved in the controller memory also there is possibility to set up new ones and to correct programs which have been written before.
- **Squeezer for metal shingles production.** Automatic production cycle is ensured by means of control processes meant for formation of preset sizes and configuration.

Not all machines are intended for carrying out of sophisticated technology cycles and therefore control system for them is very simple. In this case “SIEMENS” logical module “**LOGO!**” is used during relay circuit reconstruction. They say: “**little pigeons can carry great messages**” about this module because comprehensive facilities are hidden in the small volume and at low price. Any relay circuit can be fully changed by one block or seldom by several blocks. By means of modules can be upgraded on input and output number (till 24 inputs and till 20 outputs), we always have possibility to find an equipment at the optimal price for the specific task solution.

Module is comfortable for programming and has complete set as follows:

- logical functions
- timers
- shift registers
- frequency and analog comparators

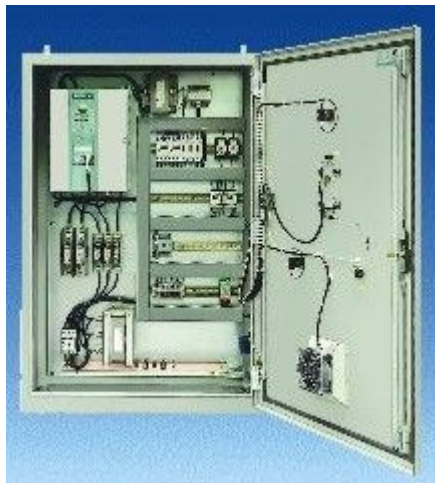


It can take some analog signals and carry out comparison operation over them with the help of comparers. Some messages are output on the module screen, it simplifies the diagnostics. «**LOGO!**» work in the wide voltage range, have relay outlets, it allows to terminate till 10 A. This series makes up by special power supply and micro-sized closing switches for three-phase loads up to 10 kilovolt-ampere.

It's carried out on the modular units as follows:

- Inclined throat shears control
- Forming press control
- Stamping press control
- Molded products press control
- Metal length cutting line control

Drive reconstruction of main movement and transmission has the special meaning, where electric motors are power elements. AC motors without rate adjustment are used in the most of machines. Rotary motion of motor rotor is transferred to the executive device with the help of multiple-speed gearbox to



choose necessary operation mode. DC motors with the spin-rate control are used in some machines. If DC operational motor is in the working condition during the machine drive reconstruction or restoration, it's enough to change old speed control system (the converter which can not be requalified and variable-voltage system) to system with the regulated thyristor converter. In this case the motor is connected to the converter directly: thyristor converter – motor system, the converter **SIMOREG DC Master 6RA70** from the firm SIEMENS showed itself to good advantage for these purposes.

Converters are produced for the wide range of currents and voltages; it permits to match equipment according to the concrete task. The converter is reliable in the work and it's comfortable in operation. Using of converters SIMOREG allows reducing equipped areas especially when the drive is modernized according to the variable-voltage system. It's achieved energy economy, control performance is higher than with magnetic or rotating amplifiers using. SIMOREG is integrated with control controllers easily, if they are used in the machine circuit. Drives with converters have the wide range of speed regulation, it allows reducing stage number of transmission, and possibility of acceleration curve forming with any desired rate and backlash takeup function reduces dynamic loads on mechanical parts of the drive, reducing wear problems and other possible damages. On the basis of this converter, the cutter drive of milling lathe was reconstructed. Operation results for 2 years have shown reliability of the equipment work and machine relay circuit have been simplified.





In cases when electric motors have to complete machine drive, the best variant of modernization is frequency regulation of rotation rate application with using of AC motors having cage rotor. Motor controlling system got the name “Frequency – Regulated Drive”.

The latest achievements of frequency converter production make the frequency – regulated drive one of the most popular systems in the regulated drives sphere. Modern frequency converters have microprocessor control system, permitting to implement full multichannel control. Amplitude and output current or voltage configuration are formed on the principle of length modulation. All of it provides work possibility in the wide range of drive motor rotation frequency without using of speed sensors (tacho-generators). It's permissible using of standard AC motors without additional filters at the output, because current configuration of motor stator is close to alternating. For the special accurate machines it's possible to order special motors which have fast response, allow increase of rotations in 2-3times more then nominal, equipped artificial ventilation, brake and pulse sensor, which allows to measure driven element movement. Possibility of motor forcing in three times excludes usage of special drive for accelerated transmissions.



The modern frequency-regulated drive considering its static and dynamic measures came very close to DC drive, but it considerably overcomes it in reliability and operational factors. High efficiency and COS which is close to 1, do the economic drive in a part of electric energy consumption. The high efficiency factor of motor protection and converter itself excludes damages and accidents either electric equipment or mechanical one.

The strategy works here **“has designed-bought-installed-adjusted-closed and forgotten!!!”**

Experience of frequency-regulated drive implementation for more than 10 years confirms it completely.

So machine drives for coil metal length cutting are completely carried out on the frequency-regulated drive (uncoiler, slitting machine, coiler), it is achieved high reliability and quality of the work.



NC machines. Usage of numerical control technique is profitable both in the large production and in separate workshops. Beginning from the end of 1970-s of last century, machinery plants began to be equipped such kind of machines, but in general they were local makes.

Mechanical equipment of the machines and their steel structures are not very worn out because they were designed and manufactured with the big assurance coefficient. We cannot say it about electronic equipment, which is often failed even on the new machines, it was necessary regular technical service. In general data entering systems were on the magnetic tapes, paper tapes and punched cards; it made additional difficulties during drawing up a programme and work demonstrativeness. That's why we can make a conclusion that it is not appropriate to restore and repair old NC systems. Won in non-recurring costs on the reconstruction you lose more during the operation, you will pay repairing and additional losses because of delays. Finally the customer will decide what is profitable at this time.

It is necessary to have individual attention for each reconstruction situation, determining what we can keep from the old system, equipment condition, requirements to NC. Nowadays control systems are offered, having modularity. By means of it a user can assemble his individual control system for different technologies and productions from the some components fast and effectively.

The firm **SIEMENS** offers total complex system for NC, with its help we can fully and effectively solve problems in the sphere of highly productive equipment. Automation equipment Siemens determined new spectres of NC equipment. Control system offers everything that is used in the high productive industry.

This integrated program for the highest requirements is called **SINUMERIK & SIMODRIVE** and include as follows.0



- **SINUMERIK** is NC system with software, input and display devices (HMI)
- **SIMODRIVE** converter system
- **SIMODRIVE. SIMODRIVE motors**

Suitable components are set up for each task, including NC systems and a drive. With the help of some modules which have full compatibility, it's possible to equip different machines. Intelligent systems for the man and machine connection are hidden in the integrated module PC (SIMUMERIK PCU), which is supplied in different variants. Powerful intelligent control and visualization system is got in combination with operator's panel SIMUMERIK, which has small sizes.

Having a lot of NC machines they can combine with the help of network and a technologist from his place controls the work of all machines, enters processing programs from his computer to the separate working places.

Series includes different motors and its control systems.

For the latest 30 years influence of computer numerical control on the machines construction has led to appearance of new machine models and mechanical automats. Today NC machine is the foundation stone of the modern flexible production.

NC machines are the ideal solving for low-volume and piece production. However, the same machines, combined in flexible lines, are used for the high production run increasingly.



Today a customer is offered NC family for the simple machines (2 axes+spindle for the turning machines and 3 axes+ spindle for milling machines). As drives can be used either modern stepper triple-pole motors (with NC SINUMERIK 802C), or AC servo-controlled drives with analog interface (with NC SINUMERIK 802C).

Using of servo-controlled drives with analog interface ($\pm 10V$) allows improving accuracy of surface finish at the same machines or today it's popular to use NC SINUMERIK 802C for the machine modernization tasks at CIS market, moreover we have the possibility to leave old drives because of it the modernization becomes cheaper. In this case we get increasing of machine production considering that new NC system is more reliable in operation and new NC functions allow reducing time of detail processing.

SINUMERIK 802C modification permits using it as simple digital indication for the digital machines. Moreover its cost is the same or lower than classical indication system, being at the market.

SINUMERIK 802D system joins to NC closely, which adds one more axis (for instance, for table control) and works with universal servo drive SIMODIRVE 611U.

Today appearance of new functions in NC allows reducing much time using machine changeovers which can take up to 90% in the universal machine from total working time. Other functions permit to escape damages of the expensive detail and tool. Tool runout also can be reduced by means of program NC functions. Increasing of surface machining quality with using NC system from the firm Siemens allows to cancel details final machining thereby not only to reduce production time (i.e. to increase productiveness), but also to decrease expensive machines park. For a long time programming was the biggest difficulty on the way of fast implementation and NC machines spreading. Special department was developed for the programs writing, where specially trained to the NC programming language people worked. It was practically impossible that operator could enter even very easy program directly on the machine.

Today Siemens offers the possibility to enter part process program in the form of usual operation card. An operator or person, entering the program on the machine directly, shouldn't know a programming language. He just enters detail circuit step by step, consisting of simple graphical elements such as a straight, an arc, a cone etc. He calculates all transitions between elements using NC system. Then tools and its motion data and material removal are simulated. Each step is supported on the display with NC system graphically, and to this end you can get 3-D dynamic simulation of part process. Such graphic simulation is so accurate that it is not necessary to use a machine for the purpose of checking operation. Then NC system forms all technological process including passes number, tools selection, spindle speed, delivery rate and the choice of

compensating values. Such program can be compiled into machine codes and used for the line of machines in future. Therefore it's possible to program at the average up to 90% of details in any production.

So, the programming is returned to the shop again, it allows, on the one hand, using technology value and experience of shop specialists, on the other hand, it gives the possibility to the specialists from the programming department to turn their mind to remained 10% and to work more efficiently. In deficit of manpower conditions such developments can bring big economical benefits.

“RVSA”, LTD., IS CARRIED OUT MODERNIZATION OF THE CUTTING MACHINES AS FOLLOWS:

1. Simoreg. Planing lathe, change of table drive with generator – motor to the drive with converter Simoreg.
2. Mill-roll lathe for milling of roughing mill back up rolls for Hot Rolling Mill (HRM-1), JSC “Arcelor Mittal Temirtau”. (Roll weight, milling diameter, length of the body) The drive with irreversible converter Simoreg is installed on current 600 A. Instead of the drive according to the generator-motor system. The special program is developed for the drive without tachogenerator, for the work with field reduction in the second zone. Blocking, braking, oiling and carriage movement control is carried out by the module «LOGO! ». Lamp and sound signalling is foreseen.
3. Milling machine with NC. Milling of sophisticated configurations, pictures.
4. Coordinate defining machine, combined with plasma cutting. The machine has NC axis movement and tools change.

