IMPROVED SERVODRIVE CONTROL SYSTEM FOR A DETERMINED CLASS OF METAL PROCESSING MACHINES

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In the report, an improved servodrive control system with a great number of positions is introduced. The block diagram of the system is quoted, and both the function of the compo - site parts and the action principle are explained. Also, an extended form of the block diagram is introduced with the purpose to fully explain some specific features and functional potentials.

All qualities of the new solution that find expression in improved dynamic indexes, increased positioning accuracy , optimum power consumption etc., are stated.

The system suggested is applicable to CN cutting machines and it is compatible with the conventional servodrives.

It is known, that the development of the up-to-date technics is characterized with a wide application of different electronic power appliances in all fields. The use of these appliances is especially notable in the automated systems for electric drive of some class of metal-processing machines . The permanently increasing requirements to the servodrives of the different working mechanisms, as the broad band of spead control, forming the most suitable static and dynamic characteristics, considerably increased rotor torques, are for now best met by servodrives, controled by a concrete CNC system. The recent tendency to considerably increasing of productiom volume and quality of the metal processing machines, imposes a completely new approach to solving the problem with the control of the working mechanisms of the production processes.

Therefore it is necessary to improve them by using scheme building elements which represent the supreme attainments of the up-to-date electronics. By this improvement we can achieve expansion of the control abilities, as well as some decrease of the energetic losses during the start-stop processes. For a comparatively great part of the working mechanisms the dinamic characteristics of the systems for automated drive control have a decisive importance. The transition process control during starting, accelerating and decelerating of the working mechanisms, belongs to this kind of characteristics. This is realized by a suitable servotransmission, providing an optimal regime of the working organs. Recently the AC servodrives for the drive axles are more often used for the tooling machines, in which up to now DC drives have been used. The offered here AC-servodrive does not contain any electromechanical wearing out parts. Besides, it does not require periodical maintenance, but it offeres higher possibilities for use and also advantageous specific weight. Compared to the conventional DC servodrives, these are characterized with considerably higher accelerating abilities, limited heating during the acceleration, as well as limited supply line loading and limited energy consumption in the different servomodifications.

The three-phase AC servodrives are adapted to all known NC-models, especially for driving the transmission axles of metal-processing machines. The control interface and the driving functions of the AC-servodrive are identical and are compatible to the standard control units. The AC-servodrives with surface cooling offer extremely high torques in connection with the rotor inertia moment, and with this they are suitable for NC vibration shears, for NC perforating feed with more than 1000 positionings per minute, for the feed of NC-knitting machines, for oscilating drives of the grinding machines, as well as for the feeding mechanisms of the metal processing machines.

In general we can say, that the optimal driving ratios for NC-supply data as a rule are obtained with the use of AC-servomotors with 2000 RPM for fast running. Finding the

power needs for driving the feed axles, as well as determining the suitable servotransmissions , and their reducing ratio, requires the study and determining of the following data for the ball-screw pair :

- main torque, maximal torque of loading, effective torque of loading ;
- Revolutions Per Minute for fast running ;
- momentum of inertial mass.

The grounds, which limit the usable RPM of the servomotor are the following :

- performance limit of the reducing ratio of the transmission ;
- increase of starting time with the inctrease of the useful shaftspead. The latter being a conventional criterion because the accelerating ability of the AC-servotransmission is very great. Therefore the times for starting and stopping without a foreign mass, which are set with choosing the transmission, should be multiplied by the extension factor :

$$P = 1 + \frac{J_r}{J_m}$$

where :

P - extension factor ;

J_r /kg.m²/ - reduced load inertia moment on the electromotor shaft ;

J_m /kg.m²/ - servomotor inertia moment .

The offered servosystem comprises the following main components :

- three-phase transformer 380 V AC / 220 V AC ;
- feeding module ; amplifier module ;
- three-phase synchronous servomotor.

The three-phase transformer, protection degree IP00, serves for adjusting the mains voltage to the incoming voltage 220 V AC of the feeding module. The nominal transformer power depends on the loading of the servomotors. On the base of the qualities of the enerdy transducer of the amplifier module,

the required transformers are small.

The feeding module serves to provide control and drive energy to the amplifier module. This is done by one source of constant voltage (intrinsic cirquit with constant voltage) comprising a buffer(damper) capacitor C_p , fed by a 6-pulse rectifier bridge and externally situated three-phase transformer from the mains supply. The buffer capasitor C_p supplies the necessary peak voltages during the fast load changes and keeps the energy preserved in generator work. In order to limit the charging voltage, a tact resistor is paralelly connected , which is activated by a check switching.

The amplifier module comprises a pulse modulated inverter with the belonging to it control and regulating functions. The AC-servodrive is identical by its driving fulctions and the interface to the drive of the conventional DC transmissions. The differences are internal in the form of a three-phase current control, controlled by a registered position of the rotor. The feeding and the amplifier modules of a multiaxial three-phase system serve for transforming the operation of the three-phase motors, excited by constant magnets in a closed cirquit for shaft-speed control. The three-phase servomotor (protection type IP65) does not need any maintenance and overhaul, and represents a synchronous motor, which is exited by a constant magnet with an integrated unit for a feedback sygnal for electronic communication.

The way of action is the following :

The feeding module and the amplifier module form a frequency converter, the control of which is done by the feedback signal unit activated by the real working condition of the servomotor. The feeding module forms from an incoming voltage, which is cinstant in its amplitude and frequency , a constant voltage, which is turned , in the power-part of the amplifier module, into a three-phase current system changing in amplitude, frequency and phase. This includes the following characteristics :

- current amplitude - corresponding to the magnitude of the driving torque received from the motor and is determined

by the deviation of the shaft-speed controller.

- frequency of the three-phase current system - subject to the required synchrony of the motor current and the induced field , from which the motor rotation frequency is taken. During this, the real rotor position is constantly introduced by the feedback signal unit of the motor.

- the phase position of the three-phase current system with regard to the rotor magnetic field - this determines the direction of the motor rotating torque and is fixed by the polarity of the controller deviation.

The feeding modules and the amplifier modules have equal dimensions with regard to the power of appliances. They are fastly and securely connected with each other by current buss bands.

From the abovestated it becomes clear, that the so offered improved AC-servosystem can find a wide use in industry.

USED MATERIALS

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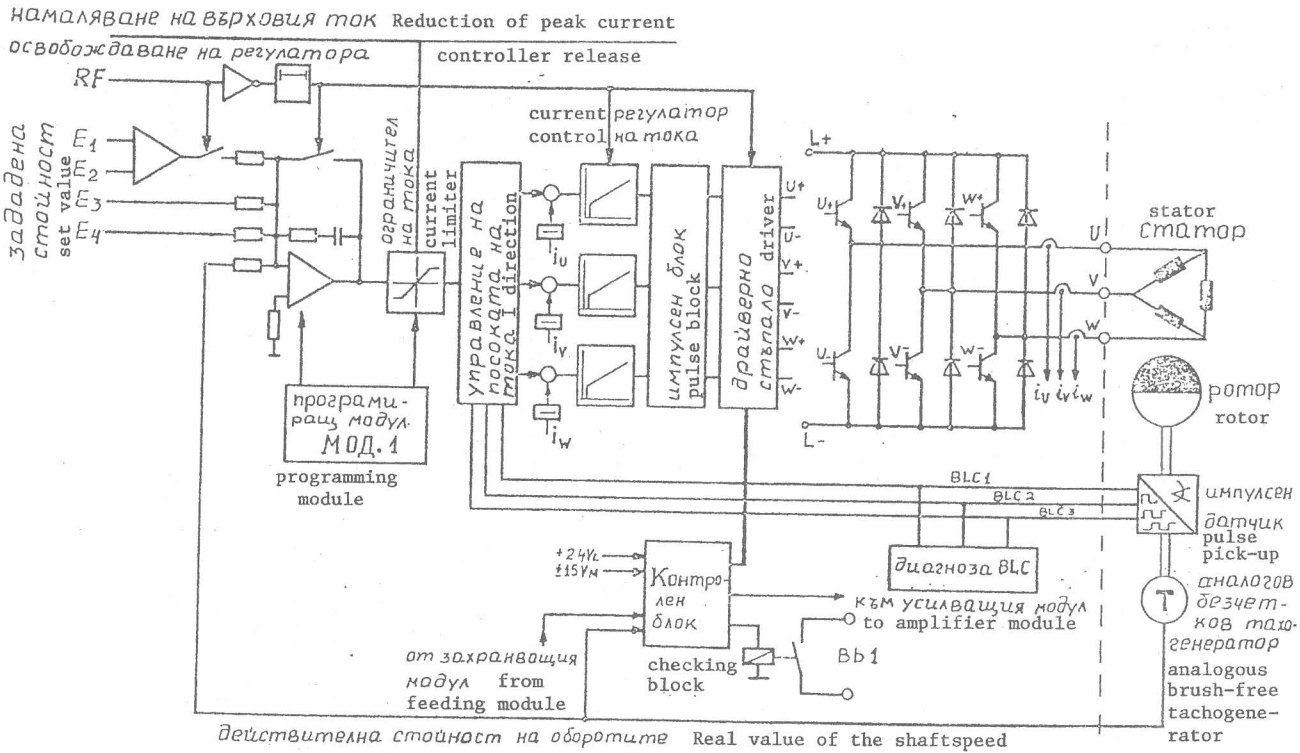
намаляване на върховия ток Reduction of peak current
освобождаване на регулатора
controller release
RF
зададена стойност
set value
E1
E2
E3
E4
ограничител на тока
current limiter
current control
регулатор на тока
управление на посоката на тока direction
iu
iv
iw
импулсен блок
pulse block
драйверна стъпала
driver
U+
U-
V+
V-
W+
W-
L+
L-
stator
статор
U
V
W
iu iv iw
ротор
rotor
програмиращ модул
МОД.1
programming module
BLC1
BLC2
BLC3
импулсен датчик
pulse pick-up
+24V
±15V
Контролен блок
checking block
диагноза BLC
към усилващия модул
to amplifier module
Bb1
от захранващия модул from feeding module
аналогов безчетков тахогенератор
analogous brush-free tachogenerator
действителна стойност на оборотите Real value of the shaftspeed