

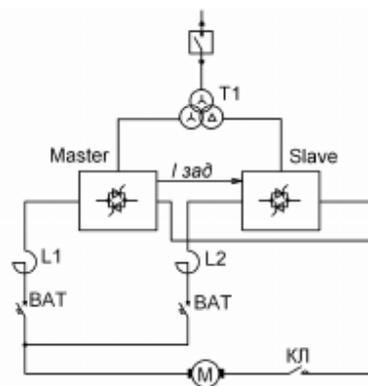
## Research of work of the thyristor drive from twelve pulsing the straightening circuit design

In powerful direct-current drives for the purpose of decrease in pulsations of voltage enclosed to propellers they eating from thyristor the converters connected on twelve pulsing to the circuit design of straightening. Process of switching of the car in this case improves, distortion of voltage of the feed source decreases. Twelve pulsing the circuit design assumes use of two complete thyristor converters, the thereupon from separate windings of the transformer with voltage phase shift between secondary windings of 30 electrical degrees that increases quantity of pulses of system to 12 for the period. Each complete device has the system pulsing - phase management, with system automatic control of key parametres of the drive, protection and signalling system system, etc. Converters in parallel work on the general loading.

The electric drive circuit design assumes use of one of converters in the capacity of the leader (Master), and the others - conducted (Slave).

In the leading converter the control system of the electric drive which starting signal is the task for a current for own contour of a current, and for contours of a current of conducted devices is realised.

One-linear cx ema turnings on of converters of type Simoreg DC Master on twelve pulsing to the circuit design it is presented on picture No 1.



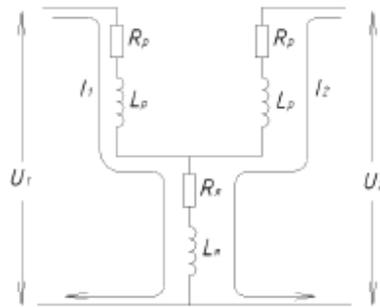
Picture No 1

Under such circuit design modernisation of the drive of the reel stand No 6 a camp of cold rolling of joint-stock company «Arselor Mittal Temirtau» has been executed. In the course of drive adjustment insufficiency of dynamic compensation during the initial moments of dispersal and a retardation, leading to undershootings and tension emissions on a strip section between the reel and the sixth cage has come to light. Change of options of correcting links in the course of adjustment have not given expected effect. Mathematical modelling and research of processes of the drive of the reel has been applied to the solution of this problem.

Dynamic processes of the drive of the reel at a shunt connection of converters proceed originally since even insignificant differences in parameters of an electric chain and a control system influences dynamics of currents of each converter and, finally, on a total current.

Presumably in investigated system on an error in compensation of a twisting moment of the propeller the transmission delay of signals from the leader to the conducted converter affected.

The equivalent circuit diagram of a power chain of the investigated electric drive is resulted picture No 2.



Picture No 2

Change of electric parameters is presented by the differential equations:

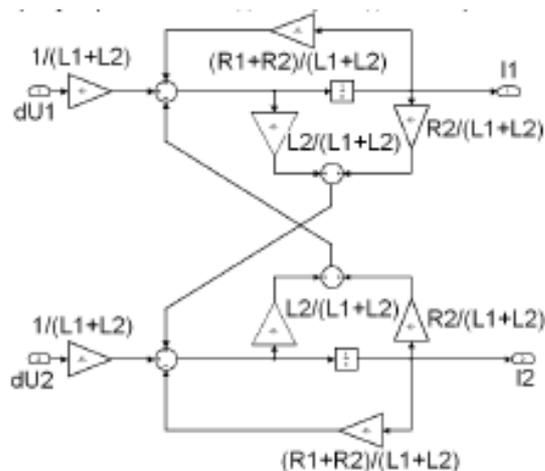
$$\begin{cases} U_1 = L_p \frac{di_1}{dt} + i_1 R_p + (i_1 + i_2) \cdot R_a + L_a \frac{d(i_1 + i_2)}{dt} \\ U_2 = L_p \frac{di_2}{dt} + i_2 R_p + (i_1 + i_2) \cdot R_a + L_a \frac{d(i_1 + i_2)}{dt} \end{cases}$$

Или:

$$\begin{cases} \frac{di_1}{dt} = \frac{U_1}{L_p + L_a} - \frac{R_p + R_a}{L_p + L_a} \cdot i_1 - \frac{R_a}{L_p + L_a} \cdot i_2 - \frac{L_a}{L_p + L_a} \cdot \frac{di_2}{dt} \\ \frac{di_2}{dt} = \frac{U_2}{L_p + L_a} - \frac{R_p + R_a}{L_p + L_a} \cdot i_2 - \frac{R_a}{L_p + L_a} \cdot i_1 - \frac{L_a}{L_p + L_a} \cdot \frac{di_1}{dt} \end{cases}$$

Having accepted, that:  $L_1=L_p$  - inductance of a smoothing reactor;  $L_2=L_a$  - inductance of an armature of the propeller;  $R_2=R_a$  - armature pure resistance;  $R_1=R_p$  - reactor pure resistance.

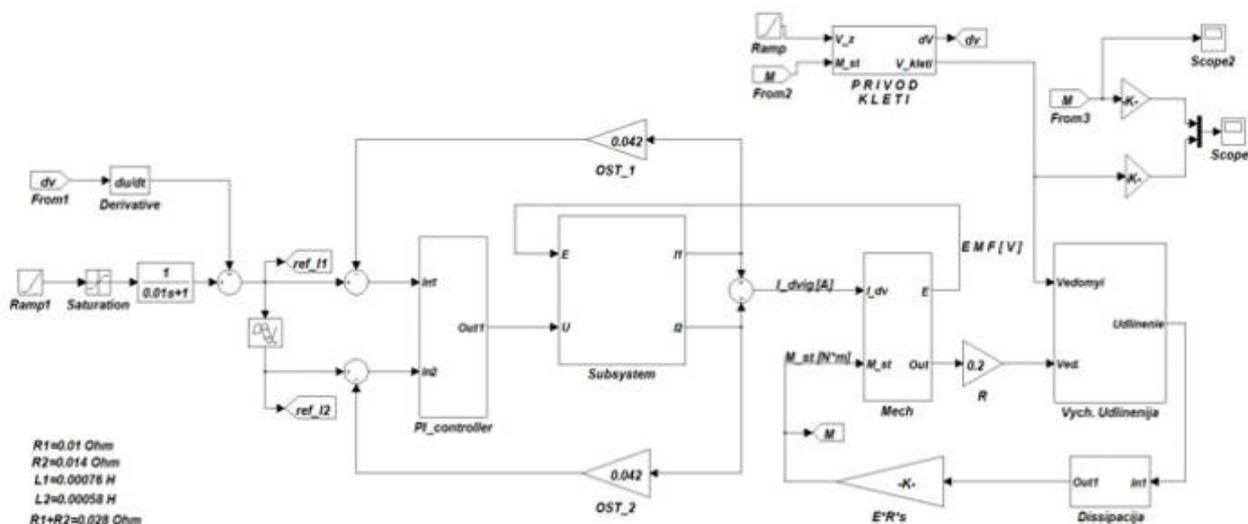
Proceeding from the equation (2), and the accepted replacement of variables, we will make mathematical model electric hour  $\tau$  a controlled process. The model is resulted on picture No 3.



Picture No 3

Where:  $dU_1, dU_2$  - arrival signals, equal differences of feeding voltage and a propeller EMF;  
 $I_1, I_2$  - starting signals - currents of converters.

Using model of an electric part as compound all system, we model behaviour of the investigated mechanism at change of speed of a strip. The electric drive model is resulted in picture No 4.



Picture No 4

The model of an electric chain of the propeller is switched on in the block «Subsystem», with model thyristor the converters representing deadbeat links of the first order.

Regulators of a current of each electric drive are presented by block "PI\_controller". Scaling of return couplings on a current of wasps уществляется blocks "OST\_1" and «OST\_2».

Dynamic compensation of a tension at change of speed of a cage is executed by the differentiation block «Derivative».

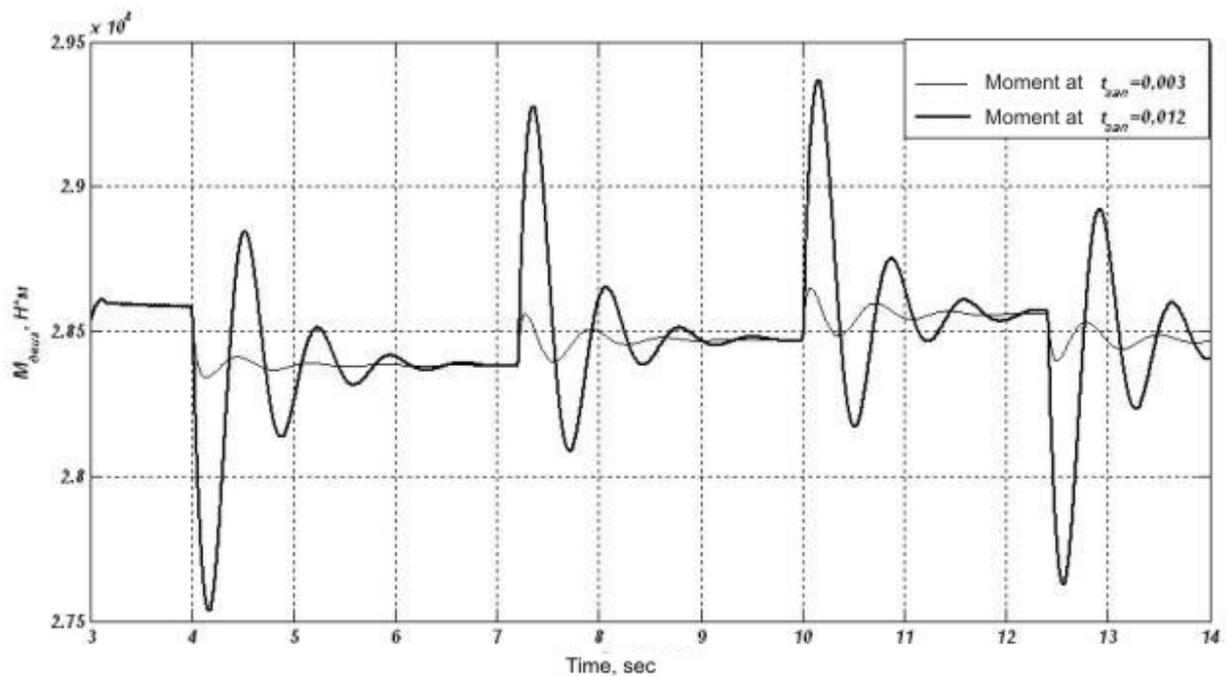
Delay in a signal transmission is carried out by the block «Transport Delay». The model of a mechanical part of the electric drive is executed in subblock "Mech".

Strip model on a section from the sixth cage to the reel, it is realised in the block «Vych. Udlinenija».

The cage model represents the electric drive of infinitely high power, is realised by the block «PRIVOD KLETI».

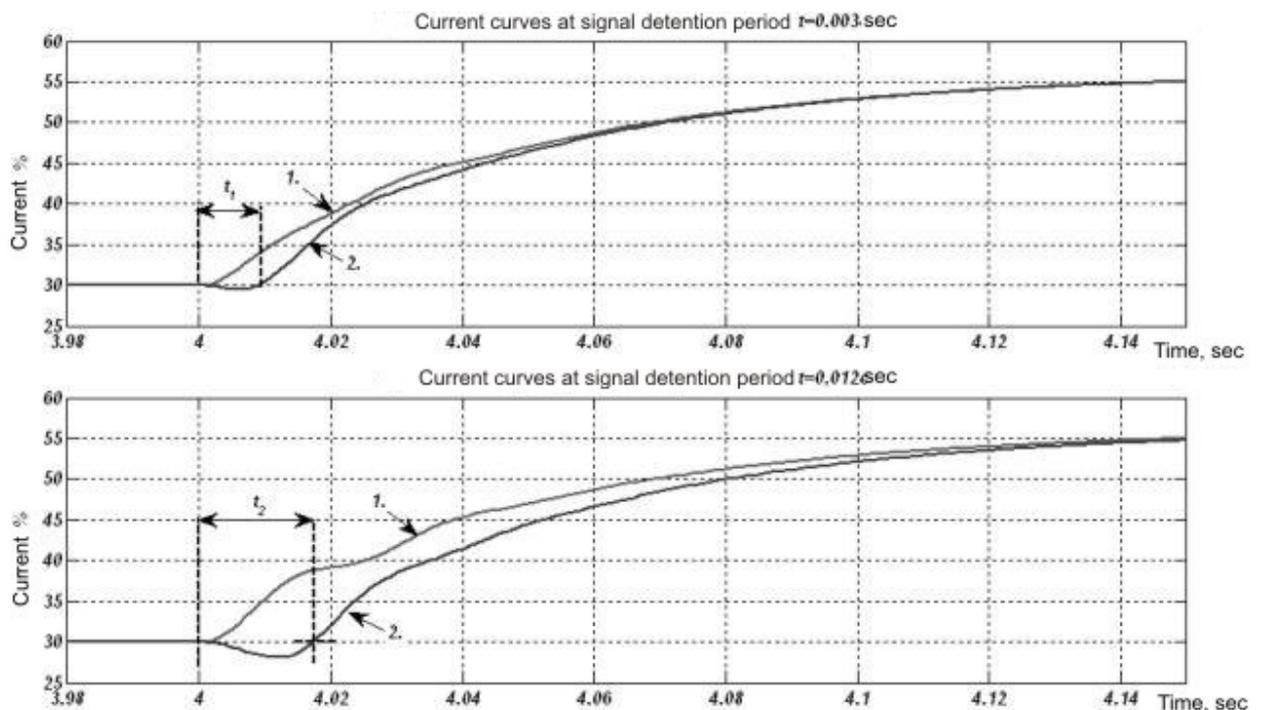
Modelling was spent by different magnitudes of delay of a signal transmission of the task of a current to the conducted converter.

In picture No 5 oscillograms of change of a tension in a strip are presented at various delay in a signal transmission of the task of a current.



Picture No 5

Oscillograms of currents of the electric drive are shown in picture No 6.



Picture No 6

### The analysis of oscillograms of a current:

In a time span  $t_1$  for the overhead drawing, and  $t_2$  - for bottom, one of currents decreases rather its previous value in spite of the fact that the signal of dynamic compensation is directed on increase in a current for the purpose of lead angle of dynamic losses a little. Current decrease occurs because of a signal time delay. The matter is that for the time delay account

Signal the current of the first converter increases more sweepingly, increase against- the EMF for the second converter, that naturally leads to decrease of its current.

During this period the total moment of the propeller more low, that leads to tension decrease by a section (picture No 6). Result of an undershooting of a tension is a number of damped vibrations of an elastic-system.

### **CONCLUSION**

The moment deviation on the shaft of the propeller of the reel in transitive regimes on speed because of delay in the channel of transfer of the task of a current on camps for thin sheets when the general tension of all of hundred kg, this deviation makes negative impact on quality of metal because of originating dynamic blows, and in some cases can lead to strip gusts. To eliminate this problem it is possible having increased speed of signalling to greatest possible.