ASYNCHRONOUS MOTOR FOR A LONGITUDINAL-CHAIN AND CROSS-CHAIN CONVEYOR OF THE WOODKRAFT INDUSTRY

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Introduction. The development of forestry and woodkraft industries in Ukraine are directly related to the electrification of technological processes. Electrification plays a leading role in the automation of all processes, in the creation of current automated lines that allow obtaining finished products, starting with sawing, transportation, wood processing, and ending with the output of a real product. Further automation and complex mechanization of industries should be carried out through the introduction of modern electric power equipment, semiconductor and computer technology and modern automated control systems based on this technology [1].

One of the main requirements for modern production equipment of powerful and small enterprises of the woodworking industry is smooth regulation of the speed of working bodies. Direct current electric motors have a number of undeniable advantages, in particular, smooth speed regulation in a wide range, but they have inherent disadvantages, such as the presence of a collector, significant power losses in additional resistances of the armature circle, etc., resistance introduced into the armature circle and etc.), significantly affect the reliability, cost-effectiveness of the electric drive and its operation as a whole.

Therefore, it is most economical to implement for electric drives production mechanisms of the field of asynchronous short-circuited electric motors with frequency control of speed, which provide the necessary static and dynamic characteristics of the drive. The frequency of the power supply network and the voltage supplied to the motor stator must change according to a certain law in steady and transient modes, and provide overload capacity. For this, the industry produces asynchronous electric drives with controlling thyristor frequency converters, which are able to successfully compete with a regulated direct current electric drive. At the same time, it is promising to use high-speed thyristor switches, which allow you to effectively act on the acceleration and braking processes of the electric drive, to carry out intensive braking, precise stopping, as well as to reproduce small and fixed movements. In addition, spark-free commutation, absence of moving parts and high reliability prove that thyristor commutators can also be used for ordinary asynchronous electric drives operating with a large number of switches, in explosive and aggressive environments, or in conditions of shaking and vibration.

In the equipment of the modern woodkraft industry, both an individual electric drive (for example, for electric saws and some types of machine tools) and a multi-motor drive (for example, on cranes and lifting mechanisms) are used.

The aim of the work is to determine the productivity of the longitudinal chain conveyor when transporting wood in one row, the resistance of the conveyor for inclined and horizontal sections and the power of the electric motor for the electric drive of this type.

Materials of research. Chain conveyors are widely used in industry for unloading wood and short assortments, transporting round lumber in warehouses, for feeding from warehouses to production warehouses of wood shops, for communication between individual units inside wood-preparation shops of the woodkraft and wood chemical industry. The main nodes of the chain conveyor are: a chain belt moving along the upper and lower support rollers (supporting structure), drive and tension stations, which remove the rollers, designed to increase the angle of coverage of the drive and tension drums. Loading of the conveyor takes place through the loading funnel. The main parameters of chain conveyors include: chain width and length, speed, drum diameter, support roller diameter, engine power. To determine the static load on the drive, the forces of movement resistance are determined and diagrams of traction forces are constructed [2]. Conveyors, depending on their purpose and field of application, can be operated in a wide variety of conditions, including extremely unfavorable ones. This fact determines the need to use electrical equipment for this group of mechanisms, which by type and performance meets the requirements of safety, reliability, and ease of maintenance.

The most common type of electric drive for chain conveyor is an unregulated asynchronous motor. Usually, when the power of the installation is up to 100 kW, an asynchronous motor with a short-circuited rotor with a double "white cage" or a deep groove is used, which has an increased starting torque. With a power from 200 to 500 kW asynchronous motors with a phase rotor with multi-stage start.

The initial data for calculation are: the conveyor works on a horizontal section *L=120 m* long, the speed of movement is *V=0,5 mps*, the distance between the logs is *α=5,5 m*, the load factor is taken to be equal to $\varphi_1=0{,}85$, the time utilization factor is taken to be equal to $\varphi_2=0{,}7$, the factor, which takes into account the resistance of the end sprockets *k=1,15*, the resistance coefficient of the chains on the guides *μ=0,2*, the linear load on the belt from the weight of the cargo is *q=72 N/m*, the linear load from the own weight of the moving parts is $q_1=34$ *N/m*, the average cubic volume of the transported wood is $Q=0{,}5\ m^3$.

We calculate the productivity of the conveyor using the formula

$$P = \frac{3600 \times \varphi_1 \times \varphi_2 \times V \times Q}{\alpha} = \frac{3600 \times 0{,}75 \times 0{,}8 \times 0{,}5 \times 0{,}5}{5{,}5} = 98{,}18 m^3 ph$$

The movement resistance on an inclined section

$$F_1 = k \times L_1 (q\mu + 2q_1 k_1) = 1{,}15 \times 30(72 \times 0{,}2 + 2 \times 34 \times 0{,}18) = 919{,}08N$$

where $L_1 = L \times \cos \alpha^o = 120 \times 1 = 120m$ − horizontal projection of the length of the conveyor at an angle of its inclination of 0º (the conveyor works on a horizontal section).

Estimated engine power

$$P = 1{,}2 \frac{F_1 \times V}{1000\eta} = 1{,}2 \frac{919{,}08 \times 0{,}5}{1000 \times 0{,}85} = 0{,}847kW$$

Based on the condition $P \le P_N$ we choose an asynchronous motor with nominal power 1,1kW from the catalog [3].

Cross-chain conveyors are used in the pulp and paper and wood chemical industry to unload balances 4-7 m long from the water, to transport them across the territory of the warehouse, to feed them to slashers for the purpose of cross-spraying or to collecting funnels to form packages, which are overloaded by cranes, etc.

The productivity of these conveyors can be very high at low speeds, which rarely exceed 0,5 mps. Thus, when transporting wood is more than 300 mm in the upper cut at diameter at length more than 6 m, the productivity of stationary cross-chain conveyors reaches 200 m^3ph or more.

The calculation of the productivity of cross-chain conveyors is carried out according to the formula:

$$P = \frac{3600 \times \varphi_1 \times \varphi_2 \times V \times Q}{\alpha} = \frac{3600 \times 0{,}75 \times 0{,}8 \times 0{,}5 \times 0{,}5}{5{,}5} = 98{,}18 m^3 ph$$

The movement resistance on an inclined section of cross-chain conveyor

$$F_C = k \times L_1 \times k_1 (\frac{G}{\alpha} + 2q_1) = 1{,}15 \times 104{,}4 \times 0{,}05(\frac{300}{5{,}5} \times 0{,}2 + 2 \times 34) = 2180{,}4N$$

where $L_1 = L \times \cos \alpha^o = 120 \times 0{,}87 = 104{,}4m$ − horizontal projection of the length of the conveyor at an angle of its inclination of 30º (the conveyor works on a horizontal section).

Estimated engine power

$$P = 1{,}2 \frac{Fc \times V}{1000\eta} = 1{,}2 \frac{2180{,}4 \times 0{,}5}{1000 \times 0{,}85} = 1{,}439 kW$$

Based on the condition $P \leq P_N$ we choose an asynchronous motor with nominal power 1,5kW from the catalog [3].

Conclusions. Based on the results of the calculations of the productivity, movement resistance on an inclined section and estimated engine power, the following conclusions can be made: 1) in the general case, the performance of the conveyor is calculated taking into account the weight of the log transported on an inclined, vertical and horizontal section by projecting the weight vector onto the horizontal section taking into account the angle of inclination, therefore, for the case of longitudinal-chain and cross-chain conveyors, it is 98,18 m^3ph; 2) the total movement resistance is also calculated as the sum of the projections on the horizontal and vertical axis, so for the two types of conveyors they are 919,08 N and 2180,4 N respectively; 3) based on the condition $P \leq P_N$ we choose asynchronous motors with nominal power of 1,1 kW and 1,5kW from the catalog for the case of longitudinal-chain and cross-chain conveyors respectively.

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