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ANALYSIS OF OPEN CHAIN DRIVES IN MECHANICAL DRIVES OF AGRICULTURAL MACHINES

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Abstract. The effect of lubrication on wear has not been sufficiently studied, and this is primarily due to the fact that thousands or more hours are required to obtain significant results of chain transmission wear. These are approximately the conditions in which machine tool transfers work. The effect of lubrication on wear has not been sufficiently studied, and this is primarily due to the fact that thousands or more hours are required to obtain significant results of chain transmission wear.

Key words: wear, chain, agricultural machines.

Introduction. The transmission of roller and bushing chains is well studied, and the scientific literature [1] presents data on the wear of their elements. So, in works [2] it is noted that the disadvantage of chain gears is uneven wear and an increase in the chain step along the links. "With wear, the pitch of the internal links remains almost unchanged, while the pitch of the external links increases intensively, which negatively affects the transmission. In addition, at some point in time, the step of the external links of the chain reaches such a value that it begins to engage through one link, i.e. it works with a double step as a long-link chain. Uneven wear of the chain on the links imposes restrictions on the choice of the number of sprocket teeth. If you select an even number of teeth, there will be increased wear through one tooth."

In most cases, the transmission sprocket is represented as a multi-square, the number of sides of which is equal to the number of teeth of the sprocket. Moreover, the step distance of the sprocket teeth is equal to the side of the polygon. The chain links that engage with the asterisk are located on each side of this polygon. For each revolution of the sprocket, the roller chain moves by the length of the polygon perimeter.

The average run-up speed of the chain V_{cp} m/s on the sprocket can be determined by the formula [3]:

$$v_{cp} = \frac{z \cdot t \cdot n}{60}, \tag{1}$$

where z – number of sprocket teeth;t – step distance circuit, m;n – speed chain transmission per minute.

The actual speed of the chain is not constant and changes periodically. The duration of the TS-1 engagement period is determined by the formula [4]:

$$T = \frac{60}{z \cdot n}. \tag{2}$$

Figure 1 shows the chain transmission elements, including the chain and the drive sprocket.

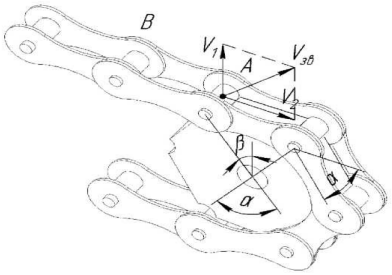

Fig. 1. Diagram of the location of the chain on the leading sprocket at the entrance to the engagement

The average speed of the hinge And at the moment can be resolved into components: the speed of lifting V_1 chain up and the speed of running V_1 chain on the sprocket. The speed V_1 is directed along the chain branch, and the speed V_1 is perpendicular to the chain branch, i.e. V_2. the Values of the component speeds are determined by the expressions:

$$V_1 = \frac{z \cdot t \cdot n}{60} \cdot \sin\beta, \tag{3}$$

$$V_2 = \frac{z \cdot t \cdot n}{60} \cdot \cos\beta, \quad (4)$$

The greatest influence on the reliable operation of the chain transmission has a change in the speed V_1 of the chain lift, which characterizes the uneven course of the chain.

Analysis of figure shows that there is no change in the speed Of the new roller chain transmission, and therefore there is no unevenness of the course. This is due to the same step distance of the external and internal links. In a worn chain, the speed of the external links exceeds this parameter of the internal links by 2 times. This circumstance indicates uneven wear of elements of external and internal links in the operation of chain gears.

The main design characteristic that determines the load capacity of a chain transmission is the projection of the support surface of the hinge, which is determined by the equation

$$F_{ОП} = d_B \cdot l_{Ш}, \quad (5)$$

$d_в$ - diameter of the rollers, mm; $l_ш$ - length of the chain hinge, mm.

Another important design parameter of the chain, which significantly affects its wear, is the pressure that occurs in the joint and is determined by the formula

$$p = \frac{S}{F_{ОП}} \le [p]. \quad (6)$$

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From formula (6) it follows that the pressure arising in the joint depends on the load transmitted by the chain (tension of the leading branch) and the projection of the support surface of the joint 113, 168. Obviously, to reduce the pressure, you need to increase the denominator of formula 6. Since the length of the chain hinge $l_ш$ is limited by the dimensions of the transmission, it is necessary to increase the diameter of the chain roller $d_в$. Increasing the diameter of the chain rollers without changing the step group will increase the load capacity and durability of the chain transmission.

The most important operational factor affecting the durability and reliability of the chain transmission is lubrication. Providing a lubricant for the chain joints increases its wear resistance, efficiency and reduces heating. The effect of lubrication on wear has not been sufficiently studied, and this is primarily due to the fact that thousands or more hours are required to obtain significant results of chain transmission wear. These are approximately the conditions in which machine tool transfers work. The effect of lubrication on wear has not been sufficiently studied, and this is primarily due to the fact that thousands or more hours are required to obtain significant results of chain transmission wear. These are approximately the conditions in which machine tool transfers work.

The negative impact of pollution on chain gear wear has long been known. "However, quantitative data on the extent of this impact on chain wear remains insufficient, which often leads engineering and technical personnel to neglect in the fight against abrasive contamination of chain drives. In V. Klot's experiments [5] contamination of bushing roller chains with quartz sand caused an increase in the wear rate by 17-20 times with periodic lubrication in the joint and up to 300 times when working without lubrication."

The study of chains has shown that their abrasive contamination reduces the durability by several tens and hundreds of times. Thus, chain drives of agricultural machines [6], which are particularly susceptible to abrasive ingress, have an actual life of 7501000 hours [7], while they are calculated to provide a lifetime of 2000-2500 hours with a 3-4% increase in the chain step.

Researchers have radically opposite opinions about the effect of lubrication in the conditions of an abrasive schlier.

Some experts suggest that chain gears should not be lubricated due to the fact that the lubricant, together with abrasive contamination, forms an abrasive paste that increases the wear rate of chain elements and sprockets. It was found that in lubricated chain gears, its elements wear out 2-4 times faster than non-lubricated ones in the presence of abrasive.

The opposite conclusion was reached by V. klot [5], who proved in his experiments that the use of a lubricant increases the wear resistance of the chain transmission and reduces the friction forces by 4-5 times.

The lubricant, its type, viscosity and other physical and chemical characteristics also have a special effect on the wear of chain transmission elements. "Plastic grease protects the joints from getting abrasive particles into the gaps between the rubbing parts, reducing wear, and liquid grease, when periodically greasing the chains, on the contrary, contributes to their penetration into the gaps. For this reason, the wear of periodically oiled chains, with intense abrasive contamination, sometimes turns out to be greater than non-oiled ones. The disadvantage of grease is its accumulation of wear products that occur in the joints." In this regard, you should use a lubricant that has a period of validity longer than the period of maintenance activities.

In addition, the operation of the chain loop is significantly affected by the temperature regime of the environment and the chain loop. This is especially true for chain drives of agricultural machines, in particular grain and forage harvesters, used, as a rule, in the spring and summer period at an ambient temperature above 30 ^{0}C. The high temperature of the chain circuit causes the lubricant to liquefy, its viscosity decreases, and at high operating speeds it is ejected from the chain joints. Research [8] has shown that the loss of the chain of lubrication with an increase in temperature in the chain joints above the environment increases in direct proportion. As the temperature of the chain drive increases from 35 ^{0}C to 90 ^{0}C, the oil viscosity decreases by 15 times.

In this regard, it should be noted that for chain drives of the open type it is necessary to apply grease. In addition, the issues of continuous supply of chain drives with lubrication devices are becoming relevant in order to improve the reliability of chain drives.

Another factor that affects the durability of chain drives is the accuracy of their installation. According to GOST 13568-97 [9], the tolerance for deviation of axes along parallelism should be 0.2 mm per 100 mm of length, and the tolerance for deviation from the flatness of the sprocket crowns with a distance between the centers of 1000 -2 mm. Such strict requirements for the accuracy of installation of the mutual arrangement of chain transmission elements are not feasible in the conditions of operation of agricultural machines. Failure to comply with the technical conditions leads to deviations in the chain transmission elements and even misalignment of the hinges relative to each other. At significant angles of bias, transverse vibrations of the chain branches are observed, which leads to a shift of the contact between the bushing and the roller to the edges of the hinge. Failure to comply with the technical conditions leads to deviations in the chain transmission elements and even misalignment of the hinges relative to each other. At significant angles of bias, transverse vibrations of the chain branches are observed, which leads to a shift of the contact between the bushing and the roller to the edges of the hinge.

The conducted research [10] has established that when the chain transmission is operating, the pressure can exceed the permissible one and if the installation accuracy standards are met, due to the actual operating conditions.

Analysis of all these factors that affect the durability of chain gears shows that the most significant are the projection of the support surface of the joint and the grease with abrasive contamination.

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