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DEVELOPMENT OF EFFICIENT CHAIN TRANSMISSION CONSTRUCTION BASED ON ANALYSIS OF CONSTRUCTIVE CHARACTERISTICS OF CHAIN DRIVES OF TECHNOLOGICAL MACHINES

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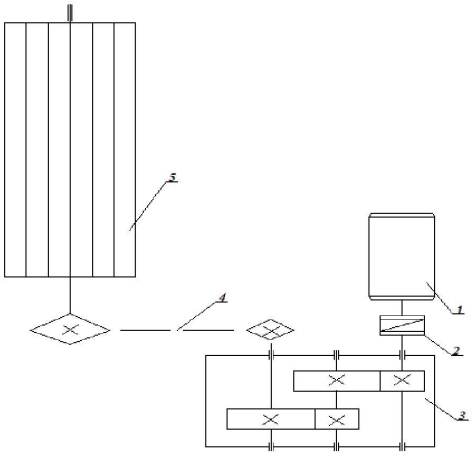
Abstract. In the article, the constructions of roller chain transmissions with a new composition, which work smoothly, have high durability, and have a longer service life, are developed for the drives of technological machines for the production of oil from plants. It is proposed to use the proposed extension structures in the handling of the seed distribution drum in the hopper.

Keywords. Chain, drive, sprocket, transmission, leader, driven, tension, roller, roller, inner ring, outer ring, ring, component, belt, pulley, impact forces, noise, flat.

Introduction. In Uzbekistan, since ancient times, vegetable oil has been extracted from the seeds of sesame, flax, indow, safflower, cottonseed, and poliza crops in oil mills. Comprehensive measures are being implemented in our republic to modernize and re-equip plant oil plants, to increase the profitability of production and processing of oil products, and at the same time, the competitiveness of manufactured products. In the direction of the conducted research, the task of improving the operation of oil-producing technological machines and the development of effective resource-efficient transmission structures was set.

Analysis of supply drum management. The seed chamber is served by a feeder of a special construction with mechanisms that increase or decrease the seed depending on the density of the seed bed during the linting period to distribute the seeds evenly. Figure 1 shows the overview and kinematic scheme of the seed distribution device in the bunker.

Seed distribution drum drive,



Kinematic diagram of distribution drum operation

Figure 1. Seed distribution device

The drive to the seed-distributing drum is transmitted by a chain drive. A mechanical transmission that transmits movement from one shaft to another using a chain is called a chain drive (Fig. 2). Chain drives are widely used in agriculture, lifting vehicles, textile and printing machines, motorcycles, bicycles, automobiles and drilling equipment. Chain drives mainly allow transmission of up to 100 kW at a speed of 15 m/sec. In special devices, this indicator provides the ability to transmit 500 kW of power at a speed of 30...35 m/s [1-4.]

There are three types of chain transmissions according to the speed of transmission:

slow moving $v = 2m/sek$;

moving at medium speed $v = 2 \dots 6m/sek$;

fast moving $v > 6m/sek$ can be divided into slow-moving chain drives are used open and lubricated from time to time (for example, in bicycles).

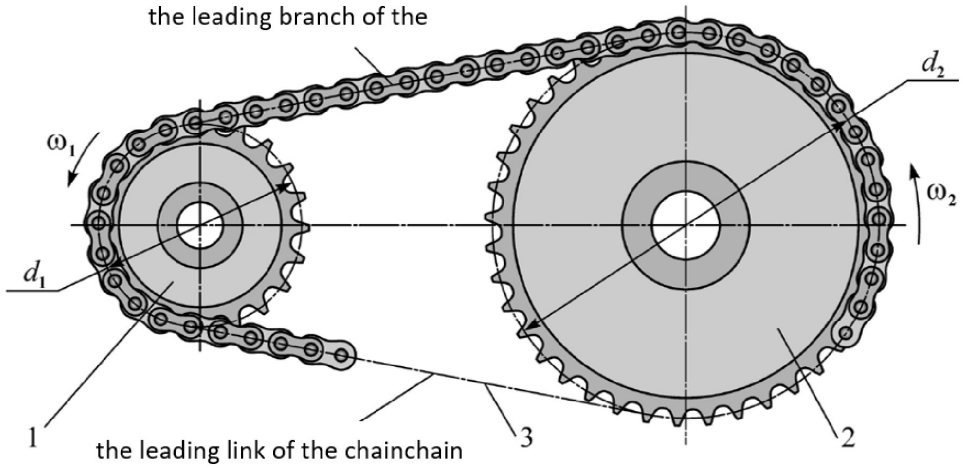


Figure 1.2. Bushing-roller chain drive construction

The following advantages have led to the widespread use of chain transmission:

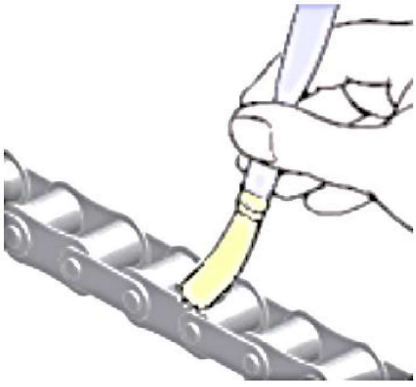
- use in a range with a large inter-axle distance;
- small overall dimensions compared to belt drive;
- absence of sliding phenomenon due to having a single kinematic connection;
- high coefficient of useful work;
- small force falling on the support of transmission shafts;
- transmission of motion to several shafts;

it is possible to emphasize the ease of replacing the chain.

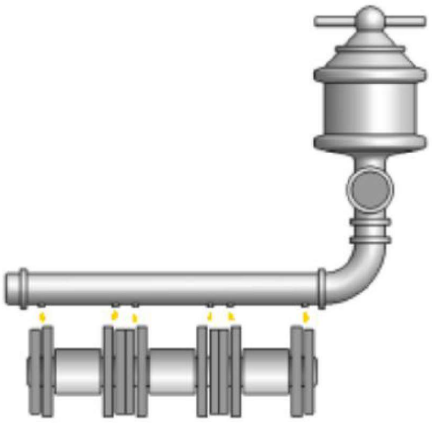
As disadvantages of extension:

- wear of chain elements due to friction in kinematic pairs;
- periodic change of transmission ratio and chain speed in cases where the number of sprocket teeth is small;
- the difficulty of making chain elements with high precision;
- it can be emphasized that the processes of lubrication and adjustment must be under constant control.

Chain drives are used in closed mode when used at high speeds, and are equipped with a protective case in accordance with external dust and other safety requirements. At the same time, the chain is lubricated by continuous dipping or spraying. Adequate lubrication of the chain ensures a long service life. Gear lubrication: manual (Fig. 3 a), drip lubrication (Fig. 3 b), oil bath (Fig. 3 c), disc lubrication (Fig. 3 d) and power (with a pump) lubrication (Figure 3 e) styles are available. The influence of the mutual kinematic friction force of chain transmission elements is high. If the chain drive is used closed or if continuous lubrication is provided, the cost of wear of the parts can be reduced.



a



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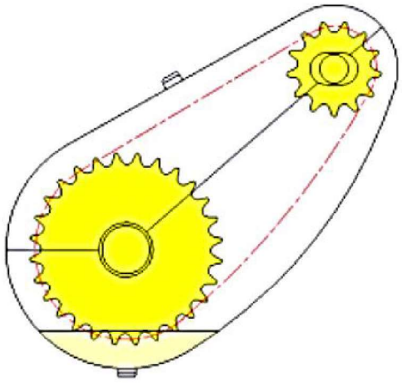

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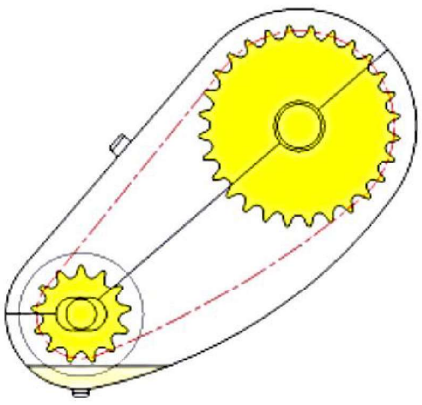

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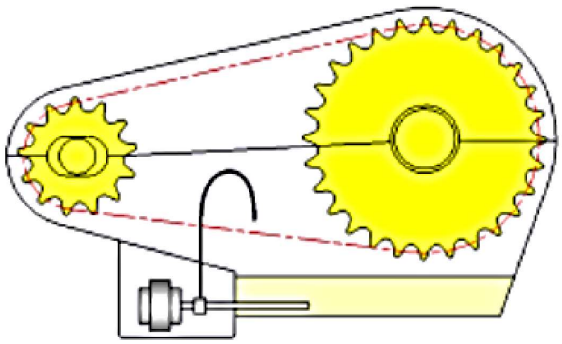


e

Figure 3. Chain drive lubrication methods

According to the number of transmission shafts, there are two-shaft and multi-shaft types of chain drives (Fig. 4). The reliable transmission of movement to several shafts at the same time is one of the unique advantages of the chain drive.

A chain transmission causes an increase in cooling during operation, a decrease in transmission reliability and technological indicators. An increase in cooling causes rapid erosion of the profiles of the transmission chain links and sprocket teeth, and a sharp increase in the longitudinal and transverse vibrations of the cooling network. Any chain drive has a minimum coolness value, and it's important to keep it consistent. Tensioning is done by moving one of the shafts, moving the tensioning sprocket or roller axis, and using the tensioning tire. Tensioning using tensioning devices is carried out periodically or with automatic tensioning sprockets, rollers or tires (Fig. 5).

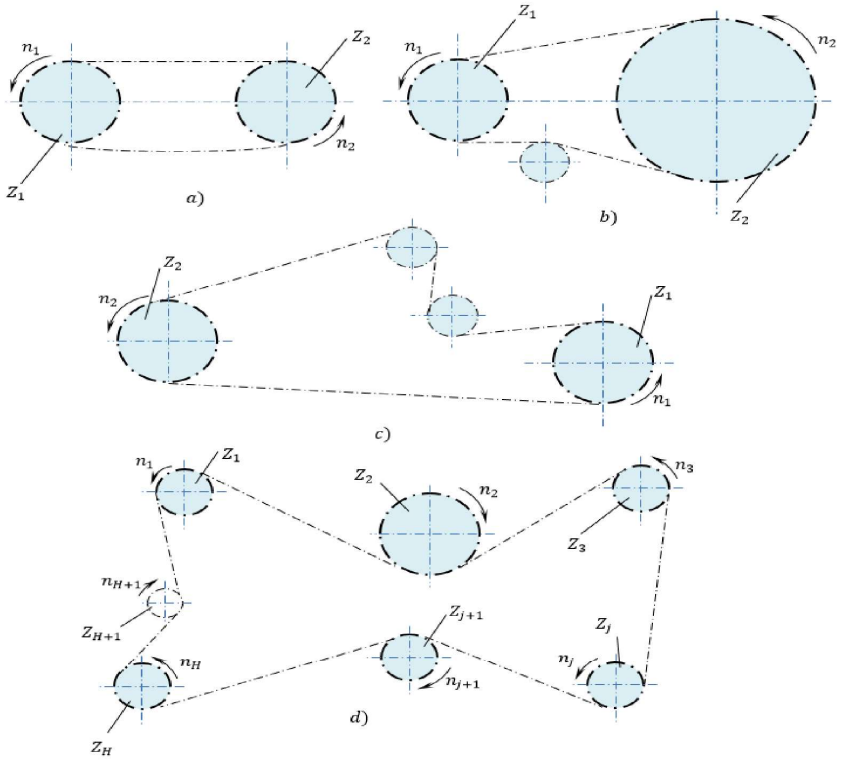
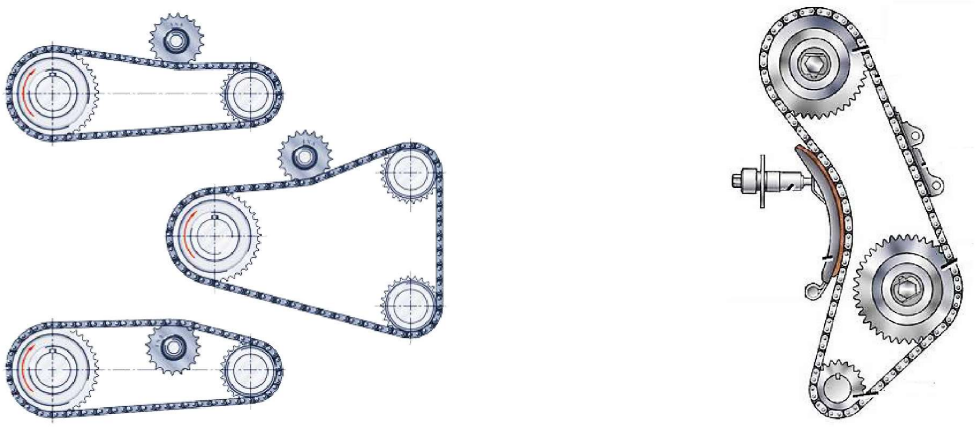


Figure 4. Schemes of two-shaft (a and b) and multi-shaft (c and d) chain drives



tension using an asterisk — tension with a tire

Figure 5. Tensioning tools

Bushing, roller and toothed types of chain drives are widely used in the operation of technological machines. Bushing and roller chains are standardized by GOST 13568-97 and silent chains by GOST 13552-81 [5-6.]

In the design of chain transmissions, the main geometric parameter is the chain pitch t, (mm) and is equal to the distance between the pivot axes. Also destructive loading according to the nature of the main force F_p, kN is considered.

It is recommended to use a roller chain drive in the mechanical drive of the seed distribution device. Let's analyze the specific structural aspects of roller chains that transmit motion in accordance with the system of our research. Today, PR, 2PR, 3PR, 4PR types of chain transmissions used in technological machines are widely used [7].

Figure 1.6 shows the single-line PR (Figure 6, a) and two-line 2PR (Figure 6, b) designs of the bushing roller chain that transmits motion. The structure consists of a roller 1, bushing 2, inner 3 and outer 4 plates and a freely moving roller 5 in bushing 2. Bushing roller chains are distinguished from bushing chains by a roller. The friction created in the working profiles of the bushing chain and sprocket reduces the working resource of the transmission, i.e. the service life. It is the rolling movement of the roller on the surface of the bushing and the formation of a high kinematic pair with the sprocket teeth that provides an opportunity to increase the service life of the transmission [8].

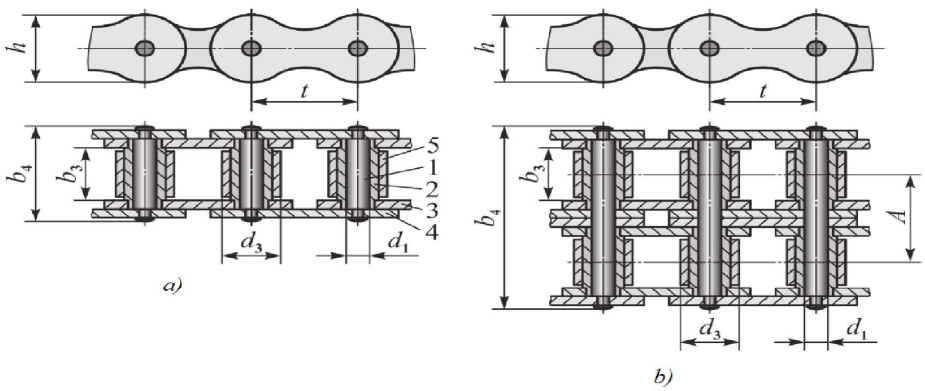


Figure 6. Construction of the drive bush roller chain: a) one-line; b) two-line

The main standard parameters of one- and two-row roller chain transmissions, which are widely used in technological machines, especially in oil production enterprises, are presented in Tables 1 and 2 below. From the tables below according to the value of transmitted power. Silent chains are distinguished by smooth and quieter operation compared to roller chains. Silent chains appeared in 1895 and began to be widely used in technological machines [9]. Their links consist of rows of tooth-shaped plates connected in a certain sequence with rollers. The ability of silent chains to work at high speeds is the basis for their wide use in technological machinery. Silent chains are developed in accordance with GOST 13552-81 in two types: PZ-1 with one-way coupling and PZ-2 with two-way coupling.]

Table 1.1

The main parameters of the single-line drive chain

Designation	t	b_3	d_1	d_3	h	b_4	F_p, kN	1 meter chain mass kg
ПР-19,05-31,8	19,05	12,70	5,94	11,91	18,2	33	31,8	1,9
ПР-25,4-60	25,4	15,88	7,92	15,88	24,2	39	60,0	2,6
ПР-31,75-89	31,75	19,05	9,53	19,05	30,2	46	89,0	3,8
ПР-38,1-127	38,1	25,40	11,10	22,23	36,2	58	127,0	5,5
ПР-44,45-172,4	44,45	25,40	12,70	25,40	42,4	62	172,4	7,5
ПР-50,8-227	50,8	31,75	14,27	28,58	48,3	72	227,0	9,7
ПР-63,5-354	63,5	38,10	19,84	39,68	60,4	89	354,0	16,0

Table 1.2

The main parameters of the two-line drive chain

Designation	t	b_3	d_1	d_3	A	h	b_4	F_p, kN	1meter chain masskg
2ПР-19,05-64	19,05	12,7	5,96	11,91	22,78	18,08	53,04	64,0	2,9
2ПР-25,4-114	25,4	15,88	7,92	15,88	29,29	24,2	68	114,0	5,0
2ПР-31,75-177	31,75	19,05	9,53	19,05	35,76	30,2	82	117,0	7,3
2ПР-38,1-254	38,1	25,4	11,10	22,23	45,44	36,2	104	254,0	11,0
2ПР-44,45-344,8	44,45	25,4	12,70	25,40	48,87	42,24	110	344,8	14,4
2ПР-50,8-453,6	50,8	31,75	14,27	28,58	58,55	48,3	130	453,6	19,1

PZ-1 type gear chains with one-way coupling are connected to the sprocket only through the inner side. Silent chains are connected in series and consist of outer 1 and inner 2 plates with a special hole opened for the support roller (Fig. 7).

Modern silent chains are made with a special hinge [10]. The rolling joint consists of two prisms 3 and 4, which are in contact with each other on a cylindrical surface. Prism 3 is pressed into plate 1 and prism 4 is pressed into plate 2 analogously. The length of the prism 3 is correspondingly equal to the width of the outer link b. The length of the prism 4 is longer and the puck 6 is inserted into the neck at its end and the end is riveted. One end of the elongated prism is riveted to connect the ends of 6 chains. A stopper consisting of washer 5 and splint 7 is installed on the other end of the extended prism 6. A guide plate 8 is installed in order to prevent the chain from coming out of the sprocket laterally.

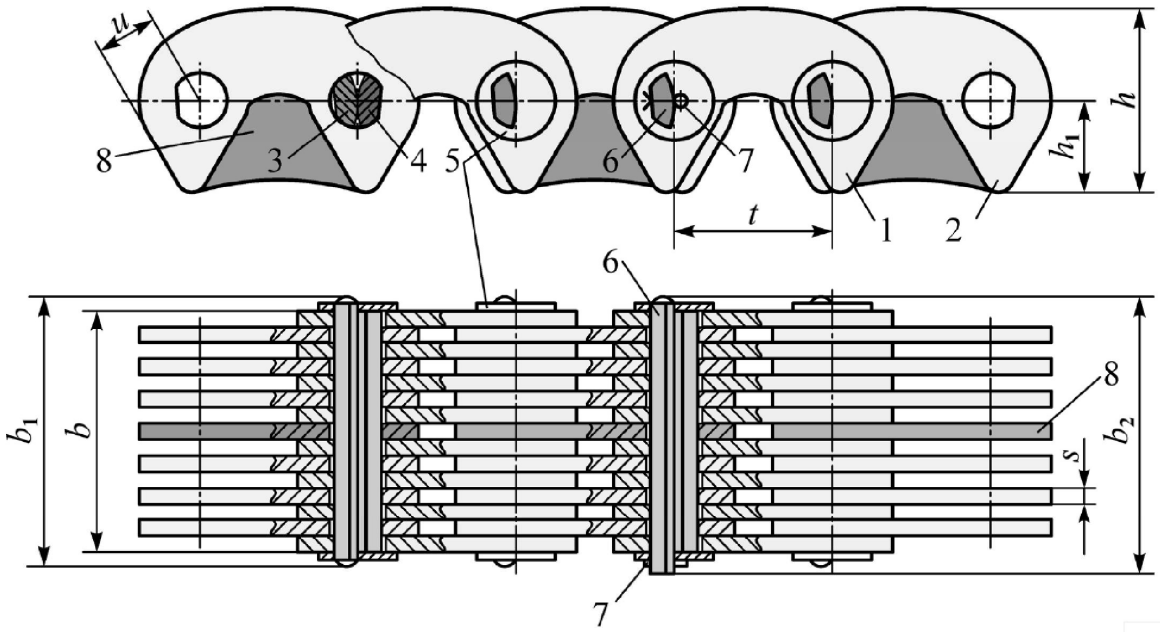


Figure 7. Gear chain drive construction

Development of efficient constructions of chain drives for drum feeder. Based on the results of the research carried out at the vegetable oil production enterprise, it can be noted that chain transmissions are used in most technological machinery. At the same time, the management structure of the enterprise's technological devices is formed in a way that does not correspond to the nature of the technological load. In the course of our research, a number of proposals were developed for improving the drum that distributes the required amount of seed to the linter. In order to evenly distribute the seed in the bunker and reduce the impact of the forces that damage the seed, three types of chain drive constructions were developed for the seed distribution drum.

Today, most chain drives introduced in technological machines are used in the open state. The conducted studies have shown that it is necessary to take into account the dusty environment rich in seed debris in vegetable oil production enterprises, and there is an opportunity to optimize the composition of technological machines. First of all, equipping the chain drives with a protective case can increase the service life and safety of the transmission. In turn, there is an opportunity to significantly reduce the level of noise coming from the transmission. In the course of the research, an effective chain drive structure was developed that is flexible to the loads on the working bodies of technological machines. One of the main disadvantages of the existing constructions used today in technological machines is the small angle of coverage of the sprocket teeth of the chain and the increase of the cooling of the driving network. As a result, we can observe that transmission efficiency decreases and noise is significantly generated. The load on the transmission and the increase in speed lead to an increase in impact forces acting on the chain roller from the sprocket teeth.

Chain drive with rubber element. The results of the conducted research show that the main reason for the increase in the complex dynamic loading of the chain transmission was the impact of the impact forces during the engagement of the sprocket and the chain. In order to reduce this negative effect, structures with increased kinematic and dynamic

capabilities were developed. The proposed chain drive structure consists of a driving and driven sprocket, a tension roller and a chain. The drive chain consists of an inner and outer plate, a roller, a bushing and a roller. The bearing roller consists of inner and outer bushings and a rubber element (rubber) located between them. The drive sprocket is made of composite material, and a rubber element is placed between the sprocket disk. The above-mentioned design is resource-saving and significantly reduces noise. As shown in Figure 8, the roller, which is recommended to be composed, has an outer bush with a bubble inside. Having the roller structure in this form reduces friction, somewhat dampens the effect of impact forces with the sprocket teeth, and creates a basis for reducing noise during operation. The extension structure consists of a driving sprocket 1, a driving sprocket 2 and a chain covering them 3, a tension roller 4. The drive is made in the form of a sprocket, and the outer part consists of a toothed flange 2, a base 6, an output shaft 7 and a rubber bushing 5. Chain 3 consists of inner 9 and outer 8 plates, roller 10, bushing 11 and roller 12 containing inner 13 and outer 14 bushings and a rubber element (rubber) 15 located between them. The strap element 15 has a concave outer surface 16 and is made to fit the inner side of the outer bushing 8 [11.]

The proposed chain transmission works in the following order: the drive from the driving sprocket 1 to the driven sprocket 2 is transmitted through the chain 3. Then, the drive sprocket 2 is transmitted to the output shaft 7 through the rubber bushing 5 and base 6. It is observed that the frictional force and other harmful forces generated between the chain 3 and the sprocket 2 are somewhat reduced when passing through the rubber element 5. When the chain 3 interacts with the guide 1 and the guide 2 sprockets, the wear of the bushing 13 and the inner 1 and outer 2 sprockets is reduced due to the deformation of the rubber element 15 in the chain roller 12. Due to the deformation of the rubber element 15, the friction between the bushing 11 and the roller 10 also decreases. This leads to an increase in the service life of the transmission elements. During operation, it is recommended that the surface 16 of the rubber bushing 15 be concave in order to center the pressure forces acting on the roller 12 from the driving 1 and driven 2 sprockets. The rubber element in the roller 12 stabilizes the external pressure forces. This will increase the service life of the chain.

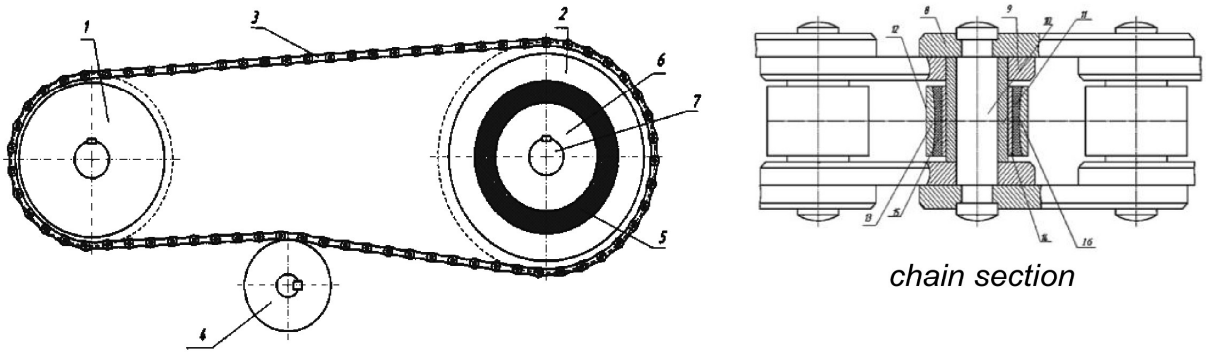


Figure 8. Chain transmission scheme with a rubber element

Chain drive with integrated centering roller. The selection of geometric parameters of chain transmissions in accordance with technological loads, at the same time, creation of self-efficient constructions of details and improvement of existing constructions were carried out.

It was observed that the chain transmissions used in vegetable oil production machines, during their operation, the longitudinal and transverse vibration movement of the chain accelerates the value of wear in the sprocket teeth and chain kinematic joints. The proposed drive structure consists of driving 1 and driven 2 sprockets and their covering chain 3, tensioning device 4. The chain 3 consists of outer 5 and inner 6 plates, a roller 7, a bushing 8 and a content roller 9 [12]. The chain roller has a composite construction. The bearing roller 9 consists of outer 10 and inner 11 bushings, and a rubber element 12 located between them. The rubber bushing 12 has a convex appearance corresponding to the outer surface 13 and a concave appearance corresponding to the inner side of the outer bushing 10 (Fig. 9).

In the proposed chain transmission, the rotary motion is transmitted from the driving sprocket 1 to the driven sprocket 2 through chain 3. When the roller 9 containing the teeth of the guide 1 and the guide sprocket 2 is in contact with the roller 9, due to the deformation of the rubber element 12, the wear of the bushing 10 and the teeth of the leader 1 and the guide sprocket 2 is reduced. In addition, the amount of friction forces between the bushing 8 and the roller 7 is reduced. This ensures that the chain transmission increases its service life and ensures smooth operation.

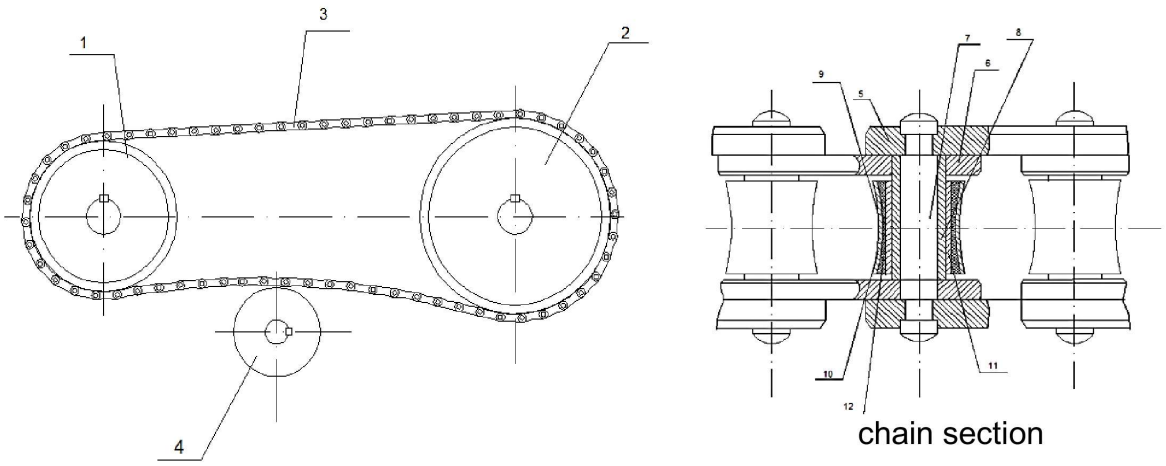


Figure 9. Chain drive with integrated centering roller

During operation, it is recommended that the edge of the bushing 9 has the feature of centering the external pressure so that the bushing 9 performs the necessary deformation when the outer surface 13 of the rubber bushing 12 is in contact with the sprockets 1 and 2. This construction reduces the level of noise and increases the service life of the transmission.

Chain drive with rubber element with ring composition. In cases where

Today, increasing the resource efficiency of chain transmissions requires the development of structures that provide an opportunity to dampen harmful forces. the movement of the chain is less than 1m/sec, a number of research studies were conducted to reduce the geometric parameters and noise value of the roller structure of the bushing roller chain transmission to the minimum level. Based on the results of the research, the construction of the roller chain transmission with a ring structure was proposed

The proposed transmission structure consists of driving 1 and driven 2 sprockets, an endless chain 3 covering them, and a timing device 4. It is

recommended that the drive sprocket is 2-component, consisting of a toothed ring 2, a base 6 and an output shaft 7, a bushing with a belt ring 5. Chain 3 includes outer 8 and inner 9 plates, roller 10, bushing 11 and content roller 12. The component roller consists of an outer ring bushing 13 and an inner bushing 14 and a rubber bushing 15 located between them [13. It is recommended to have a metal ring on the outer surface of the rubber bushing 15 (Fig. 10).

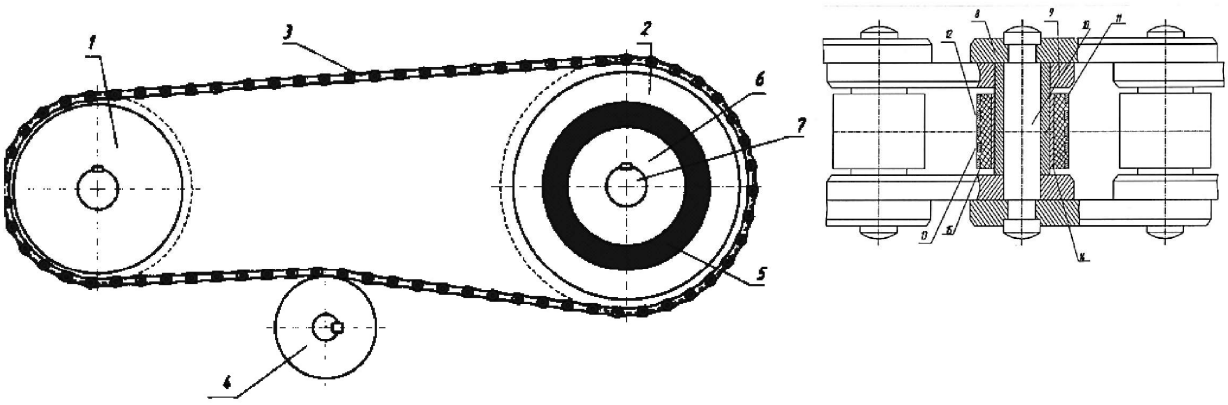


Figure 10. Chain transmission scheme with rubber element with ring composition

This chain drive works in the following order. The rotary motion is transmitted from the driving sprocket 1 to the driven sprocket 2 through chain 3. During the movement, the movement from the driven sprocket 2 is transmitted to the output shaft 7 with the base 6 through the rubber element 5. When the driving sprocket 2 turns to a certain angle, the friction, wear and damaging forces generated between the chain 3 and the driving sprocket 2 are amortized in the rubber bushing 5. As a result, the movement of the output shaft 7 is smooth and noiseless. Sufficient deformation of the rubber element 15 as a result of the action of the extension driving 1 and the driven 2 sprockets with the content roller 12 of the chain 3 prevents the wear of the ring bushing 13 and the driving 1 and the driven sprockets 2. In addition, there is also a decrease in friction forces between the roller 10 and the bushing 11 of the chain 3. The rubber bushing of the roller 12 of the chain 3 has the property of damping the unevenness of the movement from the energy source and the technological resistance. This increases the working resource and reduces the noise.

Summary. According to the results of the conducted research, resource-efficient and effective new chain transmission designs with wide kinematic and operational possibilities were recommended for driving the seed drum: a chain transmission with a combing roller with a rubber element; transmission with a chain with a rubber element; a construction of transmissions with a roller chain with a ring structure was developed.

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UDC 621.892.012

RESULTS OF A STUDY OF THE INFLUENCE OF OIL CONTAMINATION ON WEAR OF THE WORKING SURFACE OF DIESEL CYLINDER LINES

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Abstract:

Objective: to study the influence of changes in the operational properties of oils and to monitor worn cylinder liners of D-243 diesel engines and transport tractors in order to determine the influence of the lubricating properties of motor oils on the wear of the working surface of cylinder liners.

Methods: during the research, the laws of the theory of lubrication, wear friction, as well as methods based on existing regulatory documents were used.

CONTENTS