



## Development of Designs of New Efficient Chain Drives for A Combined Tillage Unit

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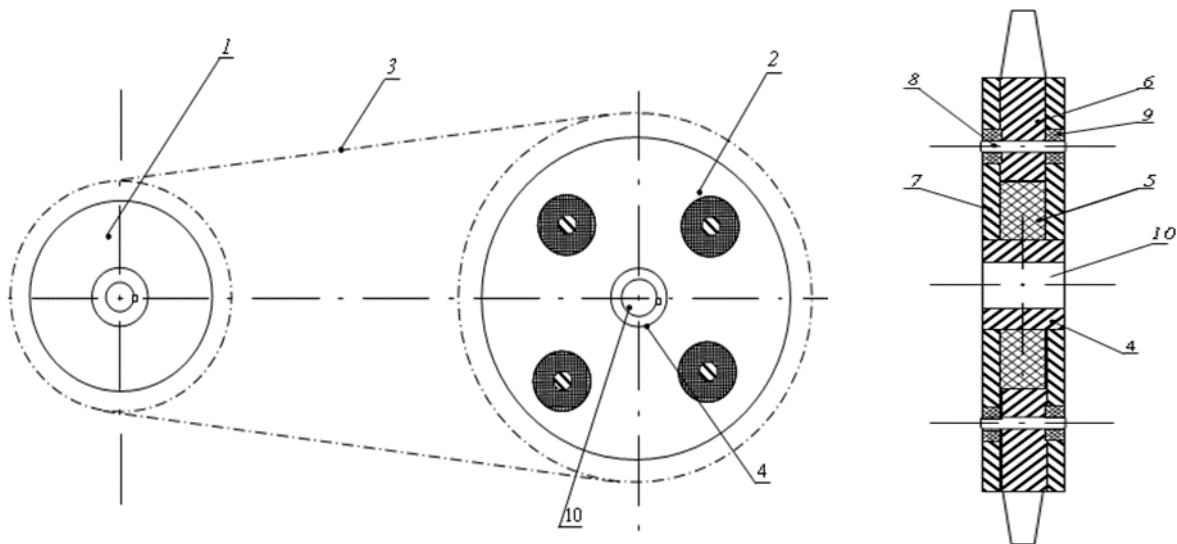
Article History	Abstract
Received: 06 June 2023 Revised: 05 Sept 2023 Accepted: 06 Dec 2023	<i>In the article, if new efficient chain transmission designs are developed, transmission reliability will increase. It is noted that this does not lead to a decrease in the coefficients of useful work.</i>
CC License CC-BY-NC-SA 4.0	<b>Keywords:</b> Combined Unit, Chain Drive, Driving Star, Driving Star, Tensioning Roller, Resistance, Torque, Link, Rubber Sleeve

### 1. Introduction

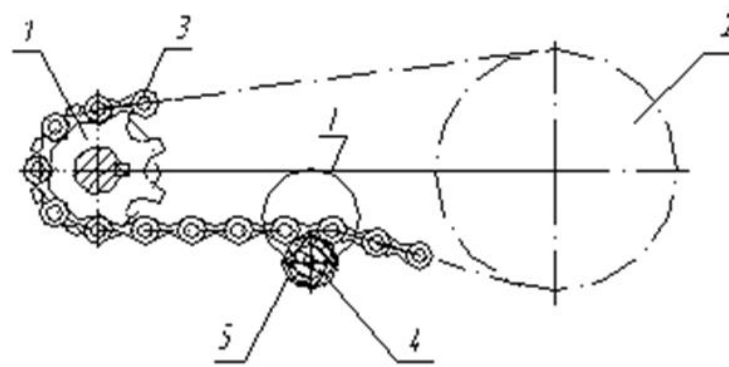
The main disadvantage of chain gears currently used in combined tillage units is the rapid wear of working profiles during operation and noisy operation, which leads to a decrease in transmission reliability and efficiency. In most cases, when chain drives operate at high speeds, the transverse vibration movement of the chain increases. This increases the unevenness of the output shaft movement. Therefore, the main task is to reduce the uneven rotation of the output shaft and reduce the impact of shock forces arising between the teeth of the sprocket and the chain links on the movement of the output shaft and noise suppression. To solve the problem, dampen the amplitudes of angular oscillations of the output shaft, reduce the impact forces and friction arising between the working profiles of the teeth of the sprocket and the rollers of the chain, connect the gap between the sprocket sleeve and the toothed belt through a strap element (rubber) sleeve and to strengthen the connection of the toothed belt with the base are fastened with discs in the form of a plate. The discs are connected to the axles in four places by a toothed belt, and the axles are attached to the discs using belt bushings. As a result of deformation of the belt and sleeve during operation, the output shaft is somewhat flattened, and the impact forces between the working profiles of the tooth and the chain are reduced. The displacement of the toothed belt and the disc pair relative to each other due to deformation of the belt sleeve is ensured by deformation of the belt sleeves located on the disc. As a result, the chain transmission has a long service life, increased reliability, quiet operation compared to other transmissions of this type, and a decrease in the unevenness of the transmitted motion.

An overview of the proposed chain drive design for efficient operation of a combined tillage unit is shown in Figure 1. below. The chain transmission consists of a drive 1 and a driven star 2, a chain 3 covering them, and an output shaft 10 (Fig. 1. a). The drive star 2 consists of a hub 4, a sprocket 6, a belt sleeve 5 pressed between them, disks 7 firmly connecting them, and rollers 8 connecting the sprocket 6 to each other from four sides, and the roller 8 is transmitted to the disks 7 through belt bushings 9. (Fig. 1.) The device operates in the following order. Rotational motion is transmitted by the drive sprocket 1 to the driven sprocket 2 through the chain 3. The belt of the drive star 6 transmits motion to the output shaft 10 through the belt sleeve 5. The bushing 5 transmits to the output shaft 10 a certain amount of damaging forces that occur when the chain 3 is connected to the drive star ring 6, as well as impact and friction forces. When moving, the sprocket 6 and the disc 7 are connected to each other in four places by a roller 8. The roller 8 is attached to the discs 7 through a belt sleeve 9 to ensure the movement of a pair of sprockets 6 and disc 7 relative to each other due to deformation of the belt sleeve 5. As a result, the operation of the transmission becomes somewhat smoother, and the deflection of the working profiles decreases. However, this structure is very complex, and its manufacture reduces economic efficiency, and the transmission accuracy is low.

If the chain drive is used for a long time at high speed, the chain rollers and sprocket teeth will make noise, and the chain will break [10], and the tensioner function will be disrupted. The transverse vibrations of the chain in the transmission also increase.



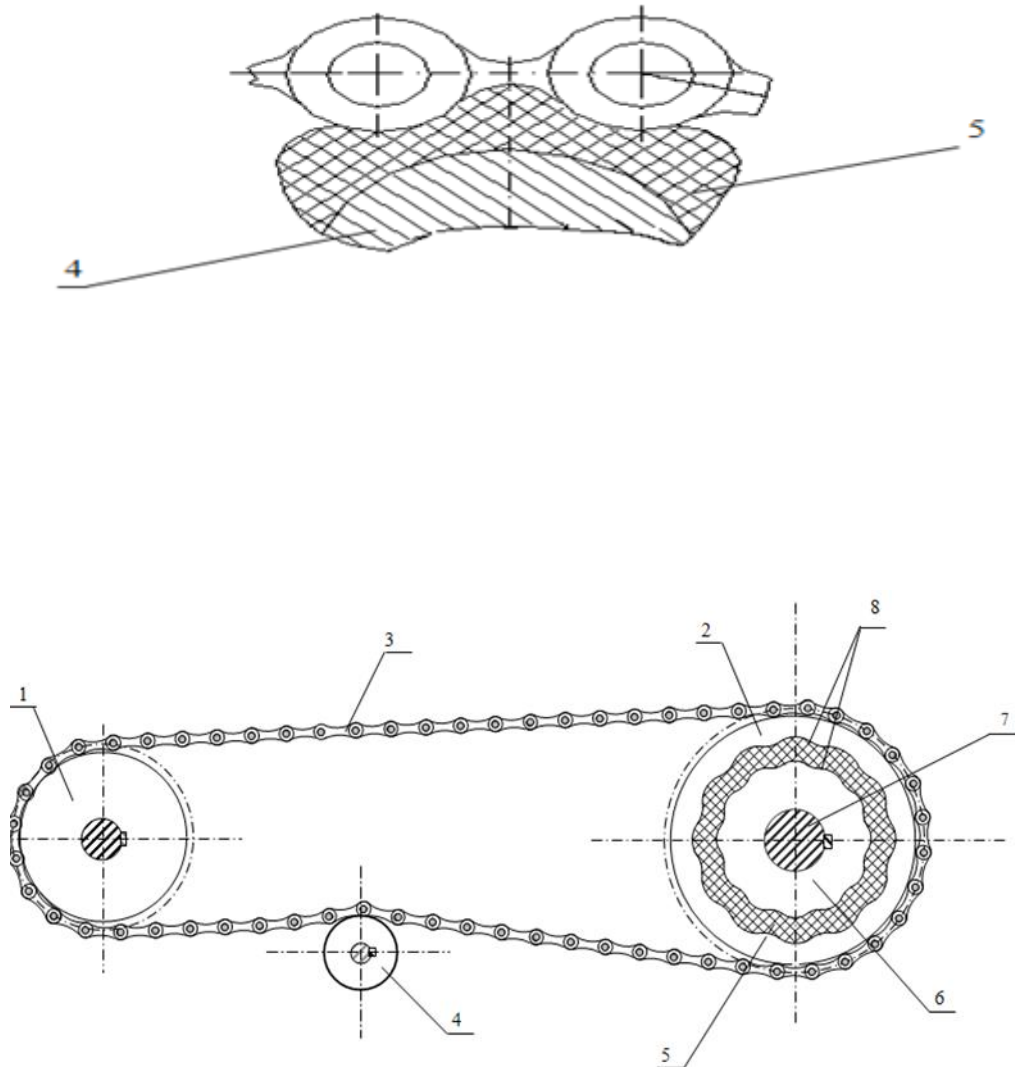
A new transmission is recommended to ensure smooth operation of the chain transmission and increase its durability. The block diagram of the chain transmission is shown in Fig. 2. The structure consists of a leading 1 and leading 2 sprockets, a chain 3 connected to them and a structural tensioning roller 4. The tensioning roller consists of 4 main axes and a sleeve 5 made of a strapping (rubber) material. The surface of the rubber sleeve 5, that is, the part in contact with the chain 3, forms a curved surface of a sinusoidal type. The pitch of this curved surface is equal to the pitch between the links of the chain 3. When the chain transmission is in operation, the drive is transmitted from the drive sprocket 1 to the drive sprocket 2 along the chain 3. In this case, the belt sleeve 5 of the tensioning roller 4 provides tension to the drive chain 3. In this case, the angle of coverage of the 1st and 2nd sprockets by the chain 3 increases, the chain 3 is eliminated from displacement (sagging) and the required tension is provided chains 3. Also, due to the interaction of the rubber sleeve 5 with the chain 3, its transverse vibrations are extinguished and its wear is reduced. Due to the fact that the sinusoidal curved surface of the rubber sleeve 5 coincides with the pitch of the chain links 3, the necessary friction between them is provided. If necessary, the tensioning roller can be installed on existing chain drives. Due to this, the extended service life is slightly increased, since the increased coverage angles reduce the forces on the teeth of the sprockets.



a

Another important disadvantage of chain gears of the existing design is that the moments of resistance forces acting on the star of the leading link act on the star of the leading link and through it affect the leading. So the complex fluctuations of the moments of resistance affect the driver almost without fading. To overcome this disadvantage, a new chain transmission design was proposed (see Fig. 3). This chain transmission has a drive 1 and a drive sprocket 2, a chain 3 and a tensioning roller 4. In this case, the drive sprocket is constructed from 2 components. A drive star 2 and a shaft 7, a sleeve 6 and a rubber sleeve 5 of the same shape 8 are mounted on its curved sinusoidal wavy surface. A guide star 2 with an inner surface of a suitable shape is mounted on the rubber sleeve 5. The design works as follows. The rotational motion is transmitted from the drive sprocket 1 to the driven sprocket 2 through a chain 3. Then the drive star 2 to 8 is transmitted to the shaft 7 through a rubber sleeve 5 and

a metal sleeve 6. The shaft 7 transmits the rotational motion to the working body of the technological machine. In this case, complex fluctuations of the moment of resistance in the working body affect the rubber sleeve 5 through the shaft 7 and the sleeve 6. At the same time, rubber 5, due to its elastic-dissipative properties, sufficiently dampens complex moment fluctuations resistance, that is, the influence of star 2 and chain 3 on star 1 is significantly reduced. It is recommended to use the recommended chain drive for a wide range speeds. The design is a bit increases term transmission services.



### Conclusion

The main disadvantage of the chain gears used in the unit is that during operation, rapid wear of the working profiles and noisy operation, the reliability of the transmission leads to a decrease in the efficiency coefficient. A new efficient chain if the transmission designs are developed, the reliability of the transmission increases and does not reduce the efficiency factor.

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