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DETERMINATION OF THE GEOMETRIC AND KINEMATIC PARAMETERS OF THE DEVELOPED CHAIN GEAR FOR THE 2SB-10 DRYER

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Abstract:

Objective. The article presents the calculated data for determining the geometric and kinematic parameters of the developed chain transmission for the 2SB-10 cotton dryer.

Methods. According to the developed drive scheme, the beater was assembled with a leading drive of the drum, consisting mainly of an electric motor with a power of 7.5 kW, a rotation speed of 1430 rpm, a gearbox with a gear ratio of 1 to 31.5.

Results. Therefore, the value of the chain pitch is limited by the maximum allowable value of the angular velocity of the small sprocket.

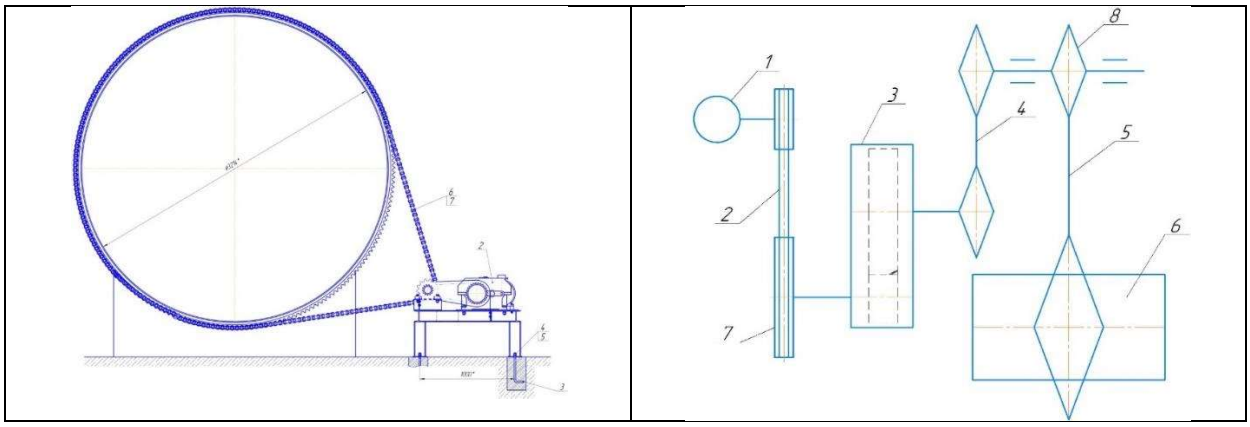
Conclusion. The given calculation data are necessary for the manufacture and assembly of the developed chain transmission for the drum dryer 2 SB-10.

Keywords: chain drive, diameter, drive, sprocket, center distance, pitch, number of teeth.

Introduction. Taking into account the analysis of previous work in the laboratory of drying, cleaning of raw cotton, “Cotton Industry Scientific Center” JSC developed a drive scheme for a 2SB-10 cotton dryer, the scheme of which is shown in Fig. 1 [1].

The advantage of the developed drive is that the generated variable loads from the side of the dryer drum are ground using the chain drive (that is, with the chain length adjustment and the choice of center distance) [2].

Methods. According to the developed drive scheme, the beater was assembled with a leading drive of the drum, consisting mainly of an electric motor with a power of 7.5 kW, a rotation speed of 1430 rpm, a gearbox with a gear ratio of 1 to 31.5. Taking into account the recommended speed of rotation of the drum dryer, which is equal to 10 rpm, the diameters of the pulleys and sprockets installed on the drive drive were selected.



1-electric motor, 2-belt transmission, 3-reducer, 4, 5-chain transmission, 6-dryer drum 2SB-10, 7-pulley, 8-sprocket

Fig.1. Diagram of a dryer drum with an improved drive (left) and a separate diagram of the leading drive (right)

The smoothness, durability and noiselessness of the developed chain transmission largely depend on the value of the chain pitch; the smaller the step, the less dynamic loads and the higher the quality of the transmission. At the same time, the static strength and load capacity of the chains increase with increasing pitch, as the dimensions of the parts that make up the chain hinges increase.

Results. Therefore, the value of the chain pitch is limited by the maximum allowable value of the angular velocity of the small sprocket. Based on these considerations, to calculate other design parameters of the chain transmission, the chain pitch is chosen equal to (Fig. 2): t = 50.8 mm, from table 1.

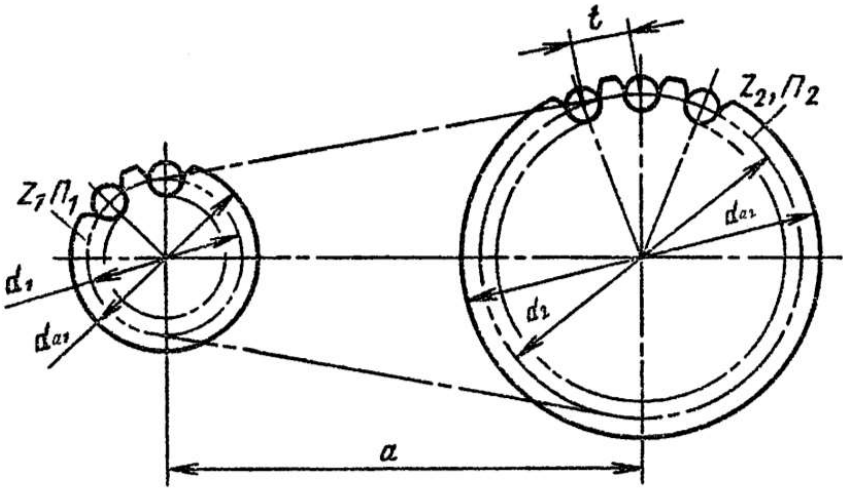


Figure. 2. Scheme for determining the geometric dimensions of the chain transmission

With the selected pitch of the flail and the known diameter of the drum dryer equal to 3200 mm, taking into account the height of the tooth, the number of teeth of the large crown will be determined as follows:

First, we determine the perimeter of the ring gear, taking into account the height of the tooth, for example, 25 mm

$$L_з = 2.\pi.\ r = 2*3,14*1,6 = 10048 \text{ mm};$$

From here, the number of teeth of the large crown will be: 10048/50,8 = 197,79 pcs.

Round up to a whole number, and take 198 pcs.

The main technical characteristics of drive chains are given in Table 1 [3].

The minimum number of teeth of the smaller sprocket for roller chains is selected according to the empirical dependence:

$$Z_{1min} = 29 - 2\ u$$

With u ≤ 2 m/s, this number can be increased to Zmin ≥ 13…15, with u ≥ 2 m/s Zmin ≥ 19, and in drives with shock loads, Zmin ≥ 23 should be taken.

Table 1

Main technical characteristics of drive chains

Parameter		Roller and sleeve single-row normal according to GOST 13568-75 (sprockets according to GOST 591-69)							Toothed according to GOST 13552-81 (sprockets according to GOST 13576-68)				
Pitch, mm			12,7	15,87	19,05	25,4	31,75	50,8	12,7	15,875	19,05	25,4	31,75
Breaking load F, kN		4,5	17,8	22,1	31,0	55,1	86,2	223,1	23,6-52,7	38,7-88,7	71,6-140,8	115,7-215,6	170,6-302,7
Inner Link Width or chain width B,mm		3,0	5,4	6,48	12,70	15,68	19,05	31,75	22,5-52,5	30-70	45-93	57-105	69-117
Roller diameter d, mm		2,31	4,45	5,08	5,96	7,95	9,55	14,29	3,45	3,9	4,9	5,9	7,9
Weight of 1 m chain q, kg		0,20	0,65	0.80	19		3,8	9,70	1,3-3,0	2,2-5,0	3,9-8,0	6,5-12,0	10-16,7
Permissible safety factor [s] at rotational speed, rpm	Before 50	-	7	7	7	7	7	7	20	20	20	20	20
	400	-	8,5	8,5	9,3	9,3	10,2	11,7	24	24	26	26	32
	800	-	10,2	10,2	11,7	11,7	14,8	16,3	29	29	33	33	41
	1000	-	11,0	11,0	12,9	12,9	16,3	-	31	31	36	36	46
	1200	-	11,7	11,7	14	14	19,5	-	33	33	40	40	51
	1600	-	13,2	13,2	-	-	-	-	37	37	46	46	-
	2800	18,0		18,0	-	-	-	-	51	51	-	-	-
Permissible pressure* in chain joints [p], MPa, at rotational speed, rpm	Before 50	-	34,3	34,3	34,3	34,3	34,3	34,3	19,6	19,6	19,6	19,6	19,6
	400	-	28,1	28,1	25,7	25,7	23,7	20,6	16,1	16,1	14,7	14,7	13,7
	800	-	23,7	23,7	20,6	20,6	28,1	14,7	13,7	13,7	11,8	11,8	10,3
	1000	-	22,0	22,0	18,6	18,6	16,3	-	12,9	12,9	10,8	10,8	9,32
	1200	-	20,6	20,6	17,2	17,2	14,7	-	11,8	11,8	9,81	9,81	8,43
	1600	-	18,1	18,1	14,7	14,7	-	-	10,3	10,3	8,43	8,43	-
	2800	-	13,4	13,4	-	-	-	-	7,6	7,6	-	-	-
The highest allowable rotational speeds - small sprocket, rpm with the number of teeth z	15	-	2300	1900	1350	1150	1000	600	-	-	-	-	-
	23	-	2500	2100	1500	1250	1100	650	-	-	-	-	-
	30	-	2600	2200	1550	1300	1100	700	-	-	-	-	-
	17-35	-	-	-	-	-	-	-	3300	2650	2200	1650	1300
Permissible number of strokes [U] per 1s		-	60	50	35	30	25	15	80	65	50	30	25

Recommended, maximum speed v, m/s		For roller chains up to 15	for bushings up to 1 / 25
Recommended number of teeth for smaller sprocket z at gear ratio	1-2	30-27	40-35
	2-3	27-25	35-31
	3-4	25-23	31-27
	4-5	23-21	27-21
	5-6	21-16	23-19
	>6	17- 15	19-27

Note: *For bush-roller chain = 15÷30; with gear =17÷ 35.

Based on the above, for our case, the number of teeth of the smaller sprocket can be chosen to be 18 pcs.

From here, the diameter of the smaller sprocket will be equal to:

d_{a1}= 914,4/3,14 = 291,2 мм.

Then the gear ratio "u" can be determined by the following dependence [4]:

$$u = \frac{n_1}{n_2} = \frac{Z_2}{Z_1} = \frac{198}{18} = 11$$

From this formula, it is possible to determine the rotation speed of the driving sprocket, based on the fact that the required rotation speed of the driven sprocket (drum dryer) will be selected within 10 rpm.

$$n_1 = 11 \text{ x}10 = 110 \text{ об/мин}$$

Center distance.

Discussions. The approximate optimal center distance of the chain drive is selected depending on the chain pitch t, usually within:

a≥ (30÷50) t (smaller values for small gear ratios) (1)

The minimum center distance **"atip"** of the chain transmission is taken depending on the gear ratio **" *u* "** of the transmission and the condition that the angle of wrapping of the chain of the smaller sprocket is at least 120 °, i.e. with u > 3

$$a_{min} = \frac{9+u}{20} \cdot (d_{a1} + d_{a2}), \qquad (2.2)$$

$a_{min} = \frac{9+11}{20}$. (3,2 +0,29) = 3,49 м

where: da1, da2 are the diameters of the tops of the teeth of the driving and driven sprocket.

The maximum allowable center distance can be selected:

a_{max}= 80t = 80x0,058 = 4,64 m.

We determine the speed v, m/s, of the movement of the chain:

$$v = n \cdot z \cdot t / (60 \text{ x } 10^3),$$

where n is the speed of the sprocket, min-1;

z-is the number of teeth of the same sprocket;

t-is the pitch of the chain.

Then:

$$v = 110 \text{ x } 18 \text{ x } 58,8 / (60 \text{ x } 10^3) = 1,94 \text{ м/с}.$$

Conclusion. The given calculation data are necessary for the manufacture and assembly of the developed chain transmission for the drum dryer 2 SB-10.

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DETERMINATION OF DRYER DRUM MOISTURE EXTRACTION DEPENDING ON ITS OPERATING MODES

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Abstract:

Objective. The article presents the results of experimental studies of a drying drum with a developed chain drive installed in a cotton gin plant to determine the moisture intake from raw cotton, depending on its operating modes.

Methods. As can be seen from table 3.5. the average values of moisture extraction from raw cotton inside the drum depend on the feed rate of raw cotton to the dryer drum and its mode of operation.

Results. This is explained by the fact that with an increase in the speed of rotation of the drying drum, the time spent by the dried cotton inside the drum decreases.

Conclusion. Thus, it can be said that the actual values of moisture extraction from the dried raw cotton located inside the drum in drum dryers depend on its productivity for dried cotton and on the operating mode, that is, on the rotation speed of the drum dryer.

Keywords: Flail, drying, drum, SB, drive, cotton, moisture extraction.

Introduction. A chain drive for a 2SB-10 drum dryer has been developed, manufactured and implemented [1].

The following revolutions of the drum dryer were investigated: 8, 10 and 12 rpm. To obtain reliable data in the compared variants of experiments, raw cotton of the second industrial grade with the same preliminary moisture content equal to 13.6%. At each repetition of the experiments, the moisture content of raw cotton after the drum dryer was determined at least three times and the actual average moisture withdrawal was determined for the compared variants of the experiments. The temperature of the drying agent for all compared variants of experiments was unchanged and set equal to 1800C. The amount of the supplied drying agent for all variants of the experiments was equal to 180,000 m3/hour. The results of the experiments are shown in table 1.

Methods. As can be seen from table 3.5. the average values of moisture

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