ANALYSIS OF FORCES AND CONTACT PRESSURES BETWEEN THE SHOE AND RIM FOR THE HOISTING MACHINES

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Abstract: *This paper presents the theoretical study of the forces and pressures for the contact surfaces shoe-rim in the case of hoisting machine type 2T 3.5X1.7A.*

1. Introduction:

The braking system represents an important part of the machine and influences its performance [1].

The basic diagram of the brake is represented in figure 1., and the tridimensional drawing of the actuating mechanism in figure 2.

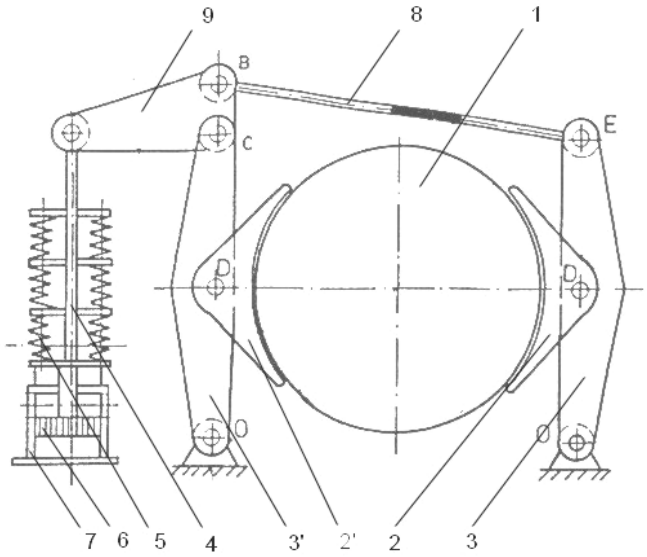

Fig. 1 The basic diagram of the brake[8]

The resultant forces between the two contact surfaces are:

- the normal force N
- the friction force T.

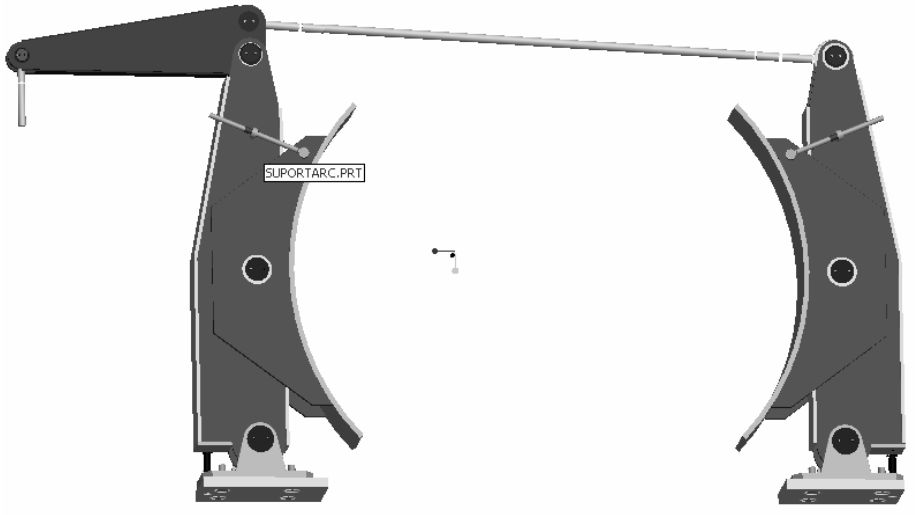

Fig. 2. The the tridimensional drawing of the actuating mechanism

2. Determination of the direction of the resultant normal force and of the distribution of pressure on the contact arc between shoe and rim.

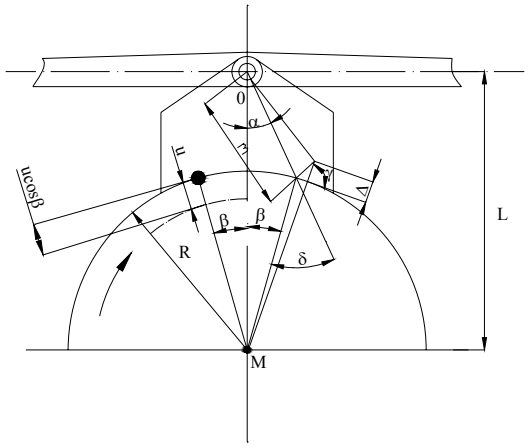

Fig.3 Deformation diagramm

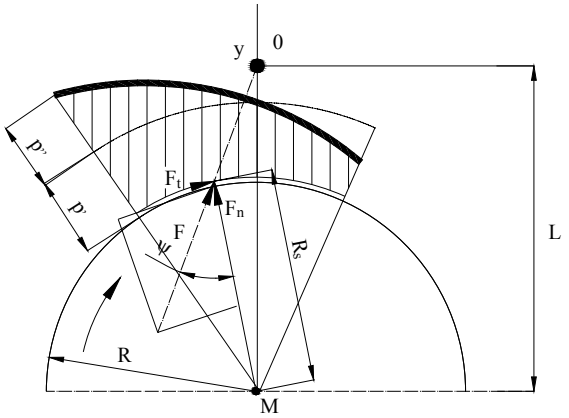

Fig.4 Distribution of pressure

During the braking the joint-fixed shoe suffers two deformations [5] (fig.)

- the radial deformation *ucosβ* because of the translation of the shoe along the OM line with the u values.
- the deformation because of the automatic rotation (self-adjustment) of the shoe round the O axis until the equilibrium position.

A part of the normal pressure p', which corresponds to the *ucosβ* deformation, varies according to the law of cosine(fig.4):

$$p' = c_1 \cos\beta \tag{1}$$

where c_1 is a random constant value.

The rotation of the shoe given the O axis will cause the deformation:

$$\Delta = \varphi m \sin\gamma \tag{2}$$

But:

$$\frac{m}{\sin\beta} = \frac{l}{\sin(180^0 - \gamma)} = \frac{l}{\sin\gamma} \tag{3}$$

Results:

$$m = \frac{l\sin\beta}{\sin\gamma} \tag{4}$$

Where:

$$\Delta = \varphi \frac{l\sin\beta}{\sin\gamma}\sin\lambda = \varphi l \sin\beta \tag{5}$$

A p" part of the normal pressure that corresponds to this deformation is:

$$p'' = c_2 \sin\beta \tag{6}$$

Where c is a constant value that depends on the brake's construction.

The specific pressure obtained through summing will be:

$$p = p' + p'' = c_1 \cos\beta + c_2 \sin\beta \tag{7}$$

To determine the dependence between the c_1 and c_2 values the equation equilibrium of the shoe will be expressed for the limit values of the angle β(+β şi –β) thus the following ratio is obtained:

$$\frac{c_2}{c_1} = \frac{2\beta - \sin 2\beta}{\mu\left(2\beta + \sin 2\beta - \frac{4R}{l}\sin\beta\right)} \tag{8}$$

The direction of the resultant normal force F_n (fig.) is β_n :

3. Analysis of the variation in time of the normal force N:

The research in the domain established that N varies according to a linear law hereby:

$$N = c \cdot N_{\max} \cdot t \tag{9}$$

Where:

- c – coefficient of variation (of non-uniformity) of the shoes pressure force on the rims;

- N - the maximum value of the normal force;
- t-the duration of the braking.

4. The normal maximum force in the case of the hoisting machine 2T 3.5X1.7A:

$$N_{\max} = \left[\left(h - h_0\right) \cdot E + m_{fm}\right] \cdot i_1 \cdot \eta_1 \qquad [7\,] \qquad (10)$$

where:

- h – the height of the compression spring
- h – the pre-tensional of the compression spring
- E – the rigidity of the compression spring
- m – the mass in the movement of the compression spring

The graphic of the variation of the normal force in this case is represented in figure 5.

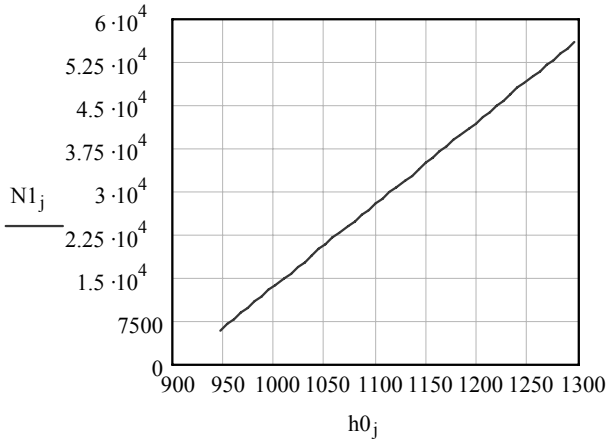

Fig.5 The normal force according to the height of the block of arcs for the hoisting machine **2T 3.5X1.7A**.[6]

5. References

1 .Banciu M., Tudoreanu N., *Îndrumător tehnic privind uzura şi oboseala componentelor frânelor maşinilor de extracţie (exemple de calcul) IPROMIN-1994.*

2. Belorov V. I.,*Dinamica nagrev i iznos tormozov şahtnâh podbemnîh maşin.Naukova dumka 1981.*

3.Buzdugan Gh.*. -„Rezistenţa materialelor aplicaţii--.”. Editura Academiei Române ,Bucureşti 1991.*

4.Mogan G.L., *Metoda elementelor finite în inginerie. Editura Lux Libris Braşov 1997.*

5.Spivacovsch A. O. Rudenco N.F., *Maşini de ridicat şi de transportat .Editura Tehnică Bucureşti 1953.*

6. Ungureanu M*., Contribuţii privind studiul sub aspect tribologic al instalaţiilor de extracţie miniere, Referatde doctorat2,Baia Mare2003..*

7.Tehnologia de revizie, reglare şi verificare a maşinilor de extracţie, CEPROM Satu Mare, etapa I, S6951.

8* * * *Maşina podbemnaia şahtnaia 2T3,5X1,7A Tehnicescoe opisanie*