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FRICTION, DEFORMATONS AND TENSIONS IN THE SHAFTS OF MILLS WITH PLANETARY MECHANISMS

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ABSTRACT
In the shafts of the grinding rolls of mills with vertical housing and activation by a planetary mechanism, additional loads are generated, resulting from the shafts' elastic deformations, caused by the friction unavoidable in such constructive designs.
In the work, by the use of modern methods, the deformations and the additional tensions generated in the course of exploitation of mills of this type, are discussed.
KEY WORDS: Grinding, planetary mechanisms, torsion shafts, friction, deformations, tensions.

The need of finely ground mineral and energy raw materials resulted in the design of a number of new grinding machines. The possible structure of such a mill is illustrated by the machine ЦРМ ВМГИ-70-А (Centrifuge-roll mill), designed at the Higher Institute of Mining and Geology "St. Ivan Rilski" (Obreshkov ,1968*)*.

ЦРМ ВМГИ-70-А has a vertical housing (Fig. 1); its operation is based on the centrifuge principle. Thus, it is downloaded gravitationally, all equations for calculation of its basic parameters being valid, such as: holding and rolling angle, free way, idle time, impact number, etc. (Вучев, 1973). As can be seen from Fig. 1, the mill consists of a central bearing knot, a housing, grinding rolls, devices for feeding in of raw materials and carrying away of the final product. Its activation is unique. It is effected by a planetary reductor at the planetary wheels, on which torsion shafts are fixed, and on the shafts, the grinding rolls are irreversibly fixed. In this way, each roll is activated by the common reductor.

Upon elaboration of the mill's prototype, it was tested (Койчев, 1975) with grinding in semi-industrial modes. These studies revealed that the mill could grind different raw materials manifesting good technical-economic parameters. The dolomite thus ground meets absolutely the requirements of road construction.

However, the strength of some of the machine's elements and its overall reliability do not meet the requirements for such machines. Yet in the end of the first 8 hours of test operation, one of the transition torsion shafts got broken at the place of the fixed connection between the grinding roll and the shaft. Upon fixing the broken shaft and increasing the shaft's diameter by 10 mm, the machine operated for 10 hours and then another shaft broke.

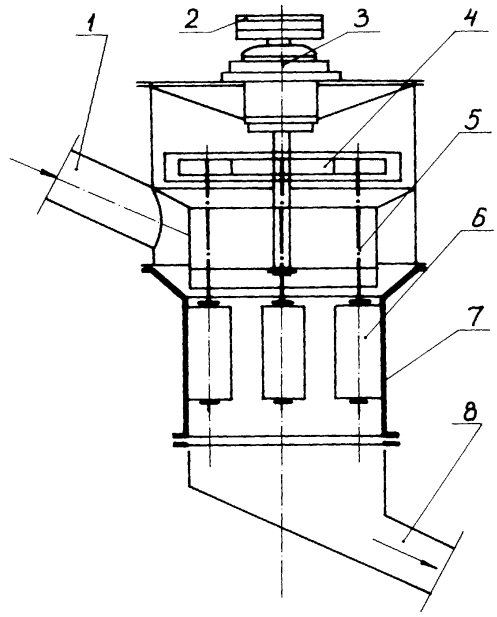

Figure 1.
1. power supply 2. activation 3. central bearing knot 4. planetary reductor 5. torsion shafts 6. grinding rolls 7. corpse 8. downloading

It is obvious that these breakings are caused by the speeded up fatigue of the shafts' material. In this case, there is considerable friction between the grinding roll, the corpse, and the ground material. It results in the shaft's lower part being greatly delayed (by about 30 mm with overall shaft length of 1080 mm) and bending in the tangential direction. Apart from this, the irregular load, and the deviations in the shafts axes-aligned directions also assist to the shafts' quick breaking.

To study the aforementioned shaft deformations and tensions, certain tests were carried out, using modern equipment and software. To model shaft geometry, the solid body modelling program SolidWorks 98+ was used, and to test strength – the program COSMOS/Works 4.0. The options of the program for the geometry's automatic shading and determination of the needed network density were used.

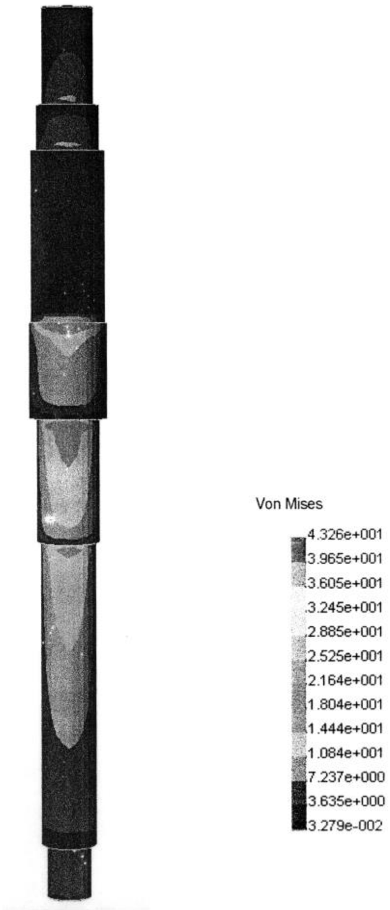

Figure 2.

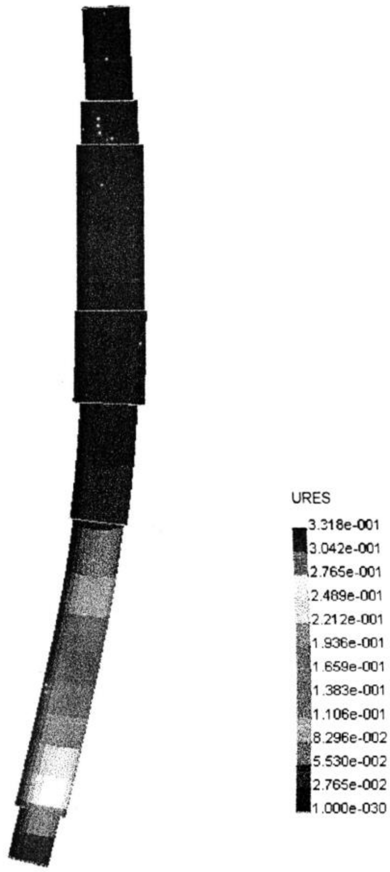

Figure 3.

As a conclusion it can be said that:

1. The centrifuge mills with planetary reductors grind well non-metalliferrous minerals, coal, and other softer materials.
2. Their hitherto available structure results in significant friction between the rolls, the milled material, and the corpse. It causes the shafts to bend in the tangential direction.
3. The irregular feeding of the milled material and some inaccuracies in their make-up increase the load and, hence, the probability for quick shaft breaking.
4. Precise studies by modern equipment and software can assist to these machines' improvement.

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