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Gyroscopic force — an alternative to gravity when creating effort disintegration of solid materials in MDF mills

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Applied in industry the means of destruction of solid rock, based on the use of force of gravitation, have a low coefficient of efficiency (no more than *3-5%*), require high energy costs and have great weight indicators, to reduce which is possible only through the use of fundamentally new physical effects on creation efforts of rock failure.

The main drawback for destruction of rocks by abrasion is to use gravity (gravity), as panacea modern technology disintegration of rocks [1]. Indeed, the strength abrasion $F_{abrasion} = k \cdot N$ depends only on the friction coefficient (k) between a rock and a working body and strength normal pressure ($N = P = m \cdot g$, where m is the mass of the working body).

The design of the regular grating mills [1] allows to increase the strength of normal pressure due to gyroscopic forces (F_{gyro}), but does not solve the problem, because the contribution of these forces is greater than *50-80%* by weight of the working the body of this mill, its value is determined by the expression

$$N = P + F_{gyro} = m \cdot g + F_{gyro} \qquad (1)$$

The essence of a radical solution of the problem is that in the balance of gyroscopic forces and the forces of gravity significantly reduce the value of the last, which is mathematically expressed by the inequality of the form

$$P << F_{gyro} \qquad (2)$$

It is possible, if you replace a hard link between the axis of the drive shaft and the axis of the tool on the hinge, and on the axis of the working body to arrange a special device - two-step gyro [2], the source of gyroscopic forces. It creates a gyroscopic moment ($M_{gyro} = J \cdot \omega \cdot \Omega$), where J is the moment of inertia of the flywheel, ω is the angular speed of the flywheel and Ω - the angular rotation speed of horizontal platform that has a gyroscope, then

$$N = P \pm F_{gyro} = P \pm M_{gyro} / L = P \pm J \cdot \omega \cdot \Omega / L \qquad (3)$$

where L is the distance between the axis of the actuator and the working body.

Formula (3) shows that the required effort abrasion rocks is defined not only the weight of the working body, but also the value of gyroscopic forces. Thus, $P = const$, and the value of gyroscopic forces you can change in wide limits on size and direction.

At the expense of independent change of angular velocities and is it possible to change the size of the pressure of the working body on the grinding table, efforts abrasion during the working process in gyroscopic mill, which also saves energy spent on the destruction of rocks.

The value of the forces involved in the formula (3) for the experimental sample of gyroscopic mills shows that $P = m_{roll} \cdot g = 0{,}01\ kg \cdot 9{,}8\ m/s^2 = 0{,}1\ H$, and F_{gyro} is calculated by the formula

$$F_{gyro} = J_{мах} \cdot \omega \cdot \Omega / L = (m_{мах} \cdot R_{мах}^{2} / 2) \cdot \omega \cdot \Omega / L \qquad (4)$$

where Mmax and Rмax respectively, the mass and radius of the flywheel of the gyroscope.

The calculations show that for values $m_{мах} = 0{,}02\ kg$, $R_{max} = 0{,}01\ m$, $L = 0{,}05\ m$, and $\omega = 400\ s^{-1}$ and $\Omega = 40\ s^{-1}$, corresponding to parameters of gyroscopic mills, $F_{gyro} = 0{,}32\ N$, which is *3,3* times greater than the weight of the working body. Design gyroscopic mill allows to increase the value of all parameters except the L, included in the formula for gyroscopic forces still twice that will increase gyroscopic forces in *32* times to the value *10,24 N*.

In this respect $F_{gyro} / P = 10{,}24 / 0{,}1 = 102{,}4$ and $P << F_{gyro}$. And in this sense will be achieved equivalence of gyroscopic forces of gravity when creating effort disintegration of solid materials in MDF mills.

The value of the achieved results illustrate the comparative data for the entire list of parameters commercially available Disc Grinders (DG) and the experimental sample of Gyroscopic Mill (GM), presented in the table.

Table

Parameters	DG-130	DG-175	DG-250	LDG-65	GM
The original size of the breed, mm	up 3	up 10	up 10	up 2	up 10
The final size of the breed, mm	0,044	0,05	0,08	0,05	0,06
Q, kg/h	8	20	40	1	23
N, kW	1,1	1,5	5,5	0,37	0,075
m, kg	55	80	160	17	5
Э = Q/N, kg/h/kW	7,3	13,3	7,3	2,7	306
Эуд = Э/m, kg/h/kW/kg	0,13	0,17	0,045	0,16	62

The table shows that the efficiency of gyroscopic mills *23* times, and the specific efficiency by three orders of magnitude larger than the disk grinders similar purpose.

Conclusions

The method is developed and tested the efficiency of the device using gyroscopic force as an alternative to the force of gravity to create the efforts of rock failure.

Biobibliography

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