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DECREASE OF IRON-ORE TRANSPORTATION COST PRICE BY SUPERSIZE TRUCKS AT THE EXPENSE OF ROLLING COEFFICIENT REDUCTION

The problem and its connection with scientific and practical tasks. The work theme coincides with the project program «TACIS» introduced in Ukraine, concerning increase of combustive-lubricating materials efficiency use.

This project has the purpose to help Ukrainian government to develop and introduce power saving technologies into motor transport and to reduce requirements for combustive-lubricating materials.

Relative density of transportation costs in overall specific expenses of mining operations at pit depth of 50-70 m makes 35-40 %, and at depth of 50-65 % - 250-300 m. Still the bigger cost transportation expenses will have in pits with project depth of 650-700 m.

Thus transportation can expenses up grow to 70 % from the overall expenses on mining operations.

The analysis of researches and publications. Nowadays, part of mining by open-pit method in ferrous metallurgy exceeds 80%, non-ferrous - 70%, to coal industry - 50%, non-metallic - almost 100%. The analysis of work of operating pits, studies of mining-technical terms, their exploitation, testifies that the main problem of the open-pit mining is becoming by the transport problem.

Without regarding to the equipment of pits by a new transport equipment, trucks by a carrying capacity 110 tons and higher, improvement of technology and organization of production, the prime price of mining of 1 t of raw ore grows with every year .

By such method a decision of task on the grounding of parameters of pit motorways is actual.

With a transition from the planned economy to to market relations considerable changes happened in the structure of domestic mining-metallurgical complex of Ukraine.

Extraordinarily quickly, passing the row of the organizational stages, it began to develop due to conception about development of mining-metallurgical complex of Ukraine to 2016 year, which is approved by Decision of Verkhovna Rada.

It is in particular marked that one of basic operating of mining-metallurgical complex conditions is reorientation of production process on resourse-saving technologies.

Exactly to this pressing question for Ukraine this article is devoted, with the purpose of the cost cutting on transporting of iron-ore heavy pit trucks and the same considerably to cut prime cost the finished good, that enable to compete Ukrainian mining raw material at the international market of iron-ore.

Statement of the problem. The substantiation of parameters of a pit ramp and its cross-section profile, and working out of methodical recommendations concerning building of a new cross-section profile of a pit ramp which will raise overall performance of supersize trucks is offered.

The cost price of transportations, expenses of combustive-lubricating materials means, deterioration of autotypes, labor input of maintenance service and servicing at the expense of decrease in factor of resistance of movement and pressure in a stain of contact of a wheel with road, thereby will raise trucks safety, and also will reduce stripping at pit-walls widening.

Statement of a material and results. Influence of constructive corners of installation of operated wheels on parameters of movement of a supersize truck .

As it is known from a car design, a wheel, has incline and toe-in. In a design of a supersize truck there is a incline and toe-in. If to look at front of the car at wheels (a Fig. 1) it is visible that the prout-axle pivot deviates a vertical on a corner α - a corner of inclined. In this connection, the distance between the top and bottom parts of a wheel isn't identical.

From above this distance will be bigger, and from below – smaller.

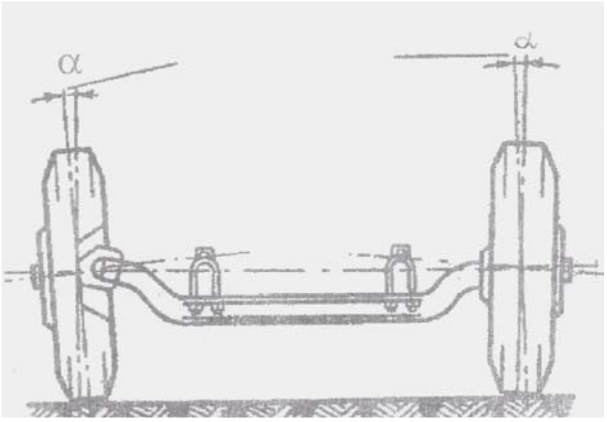

Fig. 1. Wheels disorder angle

If to look at front wheels from above, we will see that planes in which lie wheels, deviate a longitudinal vertical axial plane of the car, that is wheels have ascensions. (A Fig. 2). The ascension size is a difference of distance between wheels along the edges of their rims in front and behind (А-Б); regulate it, changing length of cross-section draft.

Prout-axle pivot and wheels are established so that to raise firmness of operated wheels during the car movement and to facilitate driving of them. Sizes of angles of installation prout-axle pivot, a angle of disorder of wheels and their ascension for each car of a steel [1-2].

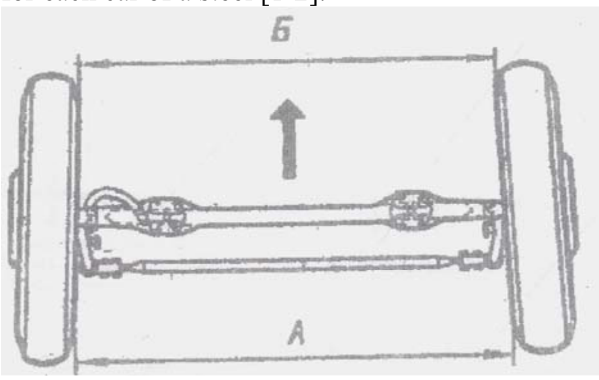

Fig.2. Convergence of wheels angles

Thus, by means of an inclination prout-axle pivot in longitudinal and cross-section directions automatic stabilization of forward wheels which supervise over direction of movement and forces which arise at rotation of inclined wheels also is provided.

On supersize trucks of mark of BelAZ, KOMATSU, KATERPILLAR various designs of a steering trapeze are applied. The steering trapeze is applied to truck of BelAZ-7512 with rotary cylinders 1, damping the device 2, and cross-section steering draft 3. The difference between the sizes A and B also should be no more than 5 mm, and an exit to a rod, the cylinder of turn B=325±2 mm (a Fig. 3) [3-6]

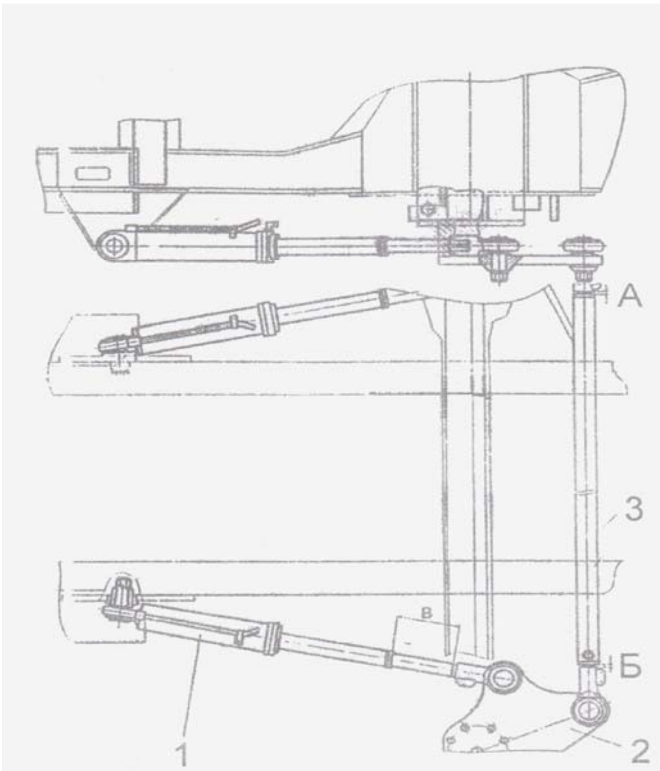

Fig 3. A steering trapeze of a supersize truck BelAZ-7512

At angle of lift, equals to 4-5º, capacity which is spent on wheel movement, approximately exceeds capacity by 3 times which is spent at rectilinear movement of these wheels. Thus the momentum force necessary for rolling of a wheel with input, can be several times more forces which needs to be put to it at rolling without pull.

Slope angles of front exle pivot on some supersize trucks are resulted in tabl. 1

Table 1

Angles of slope front exle pivot on supersize trucks

Truck mark	Angle of camber, º	Angle of wheels convergence А-Б, (mm)
БелАЗ-7512	0,5-1	5-7
KOMATSUHD-1200	0,5-1	5-7
KAT 725	0,5-1	5-7

Force which establishes operated wheels in a rectilinear direction is called as force of lateral input of a wheel and she constantly tries to turn out wheels to perpendicularly longitudinal axes of the car, this force also causes also a lateral deflection of the tire. Truck wheels which move, should slide in parallel each other, thus under the influence of the lateral elastic tire and force of withdrawal, a wheel, want to be developed: right – on the right, and left – on left. It will cause some sliding of the tire and will increase its deterioration. To reduce this sliding, a wheel is assembled with some convergence.

Change of the tire form under the influence of normal loading.

The tire directly adjoins to a road surface. Being pumped with air, it becomes elastic and capable to accept the big loadings. Under the influence of external loading the tire receives difficult deformation. This deformation for convenience of studying usually divide on simpler: normal (radial), circular (tangential), longitudinal, cross-section (lateral) and angular.

Under the influence of normal loading whole tire, all its elements is deformed. In different points of a circle of a wheel and a tire profile this deformation has different size. If rolling wheels is absent, tire deformation on a circle is distributed symmetrically concerning a vertical plane which passes through a wheel axis. The tires of a radial and diagonal design pumped up by air in a longitudinal plane of a wheel have the circle form. Under the influence of normal loading this form of various types of tires changes differently.

On size and character of distribution of specific pressure considerable influence has a wheel inclination to road.

With growth of slope angle of a wheel to road non-uniformity of distribution of specific pressure grows. Especially big non-uniformity of distribution of specific pressure is observed in a direction of a cross-section axis of contact. Pressure diagram on a contact plane has symmetry axes. The contact form is very deformed and isn't similar to an ellipse or an oval [7]. A Fig. 4

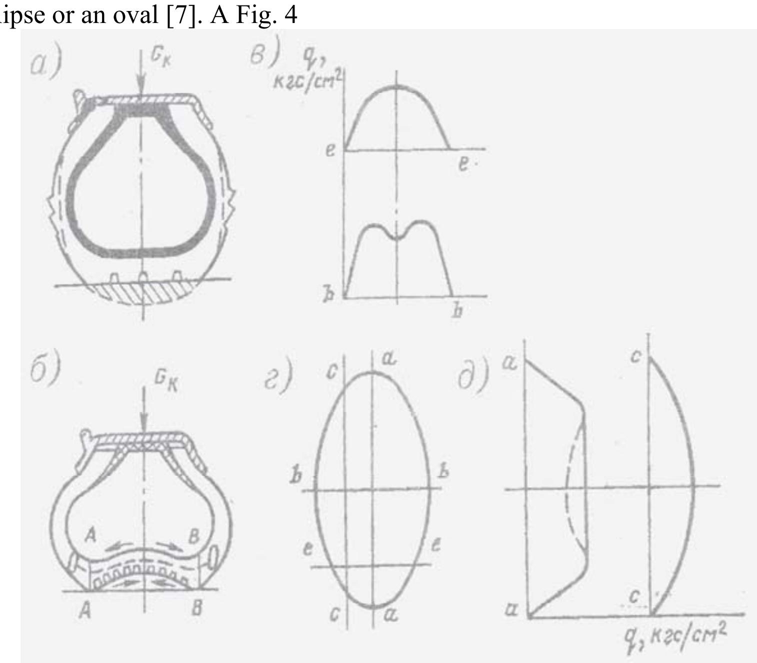

Fig. 4. Distribution of pressure on a plane of contact of a motionless wheel which leans against a rigid surface: - *a* tire profile at normal loading on a wheel; *b* - a tire profile at very heavy load; *v* - distribution of specific pressure in contact; *g* - section of a stain of contact of a wheel; *d* - pressure diagram of distributions of specific pressure

Analyzing influence of loading on the tire of a supersize truck, it is possible to draw a conclusion that deformation of the tire of a supersize truck is difficult physical process because the tire is deformed not only under weight of vertical load, but also under size horizontal and tangents of forces.

In practice operation normal rigidity depends on a number of factors, namely from dynamic modes of load, the form of a basic surface, the form and the sizes non-uniformity, temperature and tire materials.

Influence of deformation of the tire of a supersize truck on its resistance of movement.

At transition from a motionless wheel to what rotating in a range of speeds 0-5км/ч, and for separate tires, – to 30 km/h, falling of rigidity of the tire which for diagonal tires makes from 10 to 20 %, for radial – from 2до 8 % is observed. This phenomenon is connected with a relaxation in rubber and a cord, and also with non-uniform rigidity on a circle of the tire and with sliding places in a stain of contact which in radial tires is much less, than at the diagonal.

With growth of speed, from 3-5 km/h, rigidity of all tires which is connected with increase in lateral walls to a frame grows.

Resistance of movement of the tire on a road surface is found out mainly through a material hysteresis, that is a tire deflection. On the basis of experimental data, energy expenses are distributed thus: internal hysteresis expenses make 90-95 %, a friction between the tire and road of 2-10 %, air resistance of 1,5-3,5 % [7-11]

The conclusions and recommendations. That's why, decrease in the cost price of transportation of iron ore by supersize trucks at the expense of factor reduction growing rolling wheels, is an actual problem both mining-metallurgical industry and economy, ecology and transport.

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ФОРМУВАННЯ ЕКВІВАЛЕНТНОГО СТРУМУ АСИНХРОННОГО ДВИГУНА З МОДУЛЯЦІЄЮ КЕРУЮЧОЇ ДІЇ

На підставі того, що асинхронні двигуни з різних причин виходять з ладу (через перевантаження, несприятливі умови навколишнього середовища, низьку якість мережі живлення та ін.) було визначено необхідність проведення комплексу ремонтних робіт, в результаті яких двигун можна повторно експлуатували протягом тривалого часу. Визначено найбільш вразливе місце електричної машини під час проведення ремонтних робіт.

На підставі відомих раніше публікацій, в яких зазначається можливості дослідження реальних характеристик відремонтованого двигуна, було проведено якісний аналіз із зазначенням існуючих недоліків, які були б максимально зменшені з використанням запропонованої системи.

У результаті, запропоновано декілька варіантів зміни електромагнітної енергії обмоток двигуна, що дасть можливість навантажити його виключаючи можливість механічного впливу на вал. Дані обставини наочно обґрунтовуються наведеними формулами зміни частоти, напруги живлення та моменту.

Для представлення режимів роботи електричної машини у повному циклі навантаження наведено графік штучної та природної механічних характеристик із зазначенням усіх робочих точок.

Для доведення реальної працездатності запропонованої системи було проведено її моделювання з повним циклом навантаження та представлені результати у вигляді осцилограм фазових координат довільно обраного двигуна.

Величина статичного навантаження обиралась згідно з умов дотримання номінального струму та не перевищення перевантажувальної здатності асинхронного двигуна. Оскільки, за мету роботи ставилось не лише створення