

Manipulator for the Reparation of Underground Mining Wagons

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Manipulátor pre opravu banských vozíkov v hlbinnom baníctve

Článok vychádza z poznatkov, získaných riešením rezortnej výskumnej úlohy PO1-125-823 "Manipulátory pre hlbinné bane", ktorý je návrhom autorov. Pozornosť sa sústreďuje na súčasný stav v zavádzaní manipulátorov pre hlbinné bane, uvádzajú sa kritériá a podmienky ich nasadzovania.

Príspevok prezentuje manipulátor, určený pre automatizáciu opráv banských vozíkov priamo v podzemí. Navrhnuté riešenie je autorsky chránené.

Stručne sú charakterizované problémy, ale aj možnosti, ktoré robotizácia ponúka baníctvu.

Key words: automatization, underground mining wagon, manipulator.

Introduction

Mining industry is one of the most difficult branches, concerning production and technological processes. The surroundings in which we are providing these works in mines is influenced by factors like the possibility of gas explosion, harmful atmosphere, high temperature, humidity, dust, noise, vibration, etc.

The influence of these factors is increasing with a higher intensity of these works and mining in deeper parts of the deposit, especially in coal mines. All these factors lead to a decrease of the work productivity and increase the dangerous position for miners.

If we will not overcome these problems within the next 10-20 years, our coal production have less people in underground operations.

The goal to extract the minerals from the mine without an active participation of the workers, trough mechanization and automation of mining in the underground. Here is also the task to increase the cultural level of miners work in underground. The final goal is to exclude the man from the dangerous working place in the underground.

For these purposes are suitable the manipulators and industrial robots are suitable.

The Possibilities of Applying the Industrial Robots and Manipulators in the Mining Processes

The practical application of manipulators and industrial robots by extracting minerals in the world is rather seldom. But the possibilities to use them in these fields is broad and huge. We can use them by main and in auxiliary production processes or technological processes, in underground or in surface mining. The main fields are tunneling, drifting, excavating, transport, etc. Further possible applications are by benefaction, maintenance, etc.

The approach to fully automatized mining workplaces with robots and manipulators is assesed from two standpoints of views:

a) to apply the manipulators in the frame of present mining technology, machines and mining methods.

b) to apply the manipulators and robots through the principally new mining technologies.

Concerning the real and full robotization in mining (georobototechnology) we can apply it only in the second-higher innovation etape. This gift for innovations of highest order. This is connected with principally new changes in design and production of mining machines and equipments.

The condition of effective utilization of manipulators and industrial robots is their agreement and compatibility to the whole system of mining conditions, and to the surrounding. The manipulator,

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or robot should fit to the existing mining system, and his functional parameters should be obtained from the concrete working mining place. The reality is that certain automatic manipulation, or the whole production process in the whole mining system is done through manipulator, this situation in turn should influence the whole mining operation, and the concrete mining technology.

For the steps of application of manipulators and robots in the mining industry we should accept basically three variants of application:

- individual application,
- group application,
- complex application.

From the present art of mining technology we can apply robototechnology complex mainly in this operations:

- drifting
- extraction
- haulage
- informational operations, etc.

In Tab.1 are specified the requirements of mining industry for the producer of manipulators and industrial robots.

We can say, that at present time (also not in the world scale) the produced manipulators, or robots are not fulfilling all these requirements.

In the Tab.2 the possibilities, which can be obtained from the robototechnology in the mining, are shown.

Tab.1. The requirements for manipulators and robots in the mining (Fabian & Badida, 1986).

Adaptability on the continuous changing in the surrounding conditions (the higher intelligence of robots - built in the micro computer - robots of 3rd, and higher generation).
The ability to move - with moving of drifting face, extracting front, support (solving the robot movement, which can be the base universal mining robot with different functions, or multi purposes units).
The ability of manipulation or fulfilling the working operations with pieces of biggest weight (in mining this is 100-300 kg without catching unit, or by more purposes units with weight of 1t, or more).
The ability for orientation in darkness.
The kinematics solution must correspond with the narrow spaces in the mine.
The robust design for the most difficult working conditions: humidity, vibration, rock burst, dust, higher ambient temperature, gas, etc.

Tab.2. The goals of robotics in mining.

The removing the miner from the constant working process.
Removing the miner from a dangerous working zone. Decrease the number of miners on some working places in the mine.
The possibility to mine very thin coal seams (thickness under 0,7 m).
Application of robots on the surface, benefaction and maintenance places.

Manipulator for the Repairation of Mining Railway Wagons in Underground

In the underground mining the damage of transport means-mining wagons is common, especially their wheels and lower carrying parts. In many cases we have to take them out from the mine and repair them in the repair on the surface.

It is not advantage not to take every damage wagon out from the mine, but repair them in underground in repair place (close to the shaft, on certain mine level), equipped with universal manipulator.

With this manipulator we have on every wagon to make disassembly of damaged wheels, bearings and damaged parts, than to clean and grease of wheels. After repair we have to assembly all wheels and repaired parts on the wagon. All this working operation by repairman is a tedious and time consuming activity.

For repair purposes in the underground he authors of this article have designed an original solution of repairing underground mining wagons with a manipulators. Our design comes out from analyzing and fulfilling certain repair steps and operations. (Badida, Fabian, 1989). Our design and our manipulator type BM 01 has some classical and some original solutions.

Through our manipulator BM01 we can remove the demigod wagon from the rails in repair place at underground, his positioning to the place of next his repair. Further put the wagon to the position of removing 2 wheels from one side, than twist over and removing again the rest of 2 wheels. After the repair of these damaged wheels, we can assembly these wheels to the original axis of the wagon.

On the beginning of wagon reparation the whole wagon must be fixed in solid steel cage. During the twisting of this steel cage with wagon the repair man can not come closer to the dangerous place during the cage rotation.

The cycles of the manipulation and rotation of the steel cage with the wagon is shown on Fig.1. Here are the steps:

- pushing the faulty wagon to the point A,
- motion of the unit from the point 0 to B,
- the motion of lifting unit from point B to point A,
- catching the wagon,
- lifting the wagon,
- motion the wagon from the point B to the point C,
- swinging the wagon on the right side,
- disassembling and assembling the right side of wheels carrying part,
- swinging the wagon to the vertical position,
- vertical rotation of the wagon,
- swinging the wagon on the left side,
- disassembling and assembling the left side of wheels and carrying part,
- swinging the wagon to the vertical position,
- lifting the wagon down,
- release the wagon,
- motion of the lifting unit from the point D to the point C,
- motion of the mowing unit to the position D,
- departure the repaired wagon from the point D.

This mining manipulator - type BM 01 has four degrees of freedom. It is in universal design with the possibility to choose the size and position of underground repair hall. It has 5 main components: movable, rotation, lifting, swinging and chatting unit. The driving unit is hydraulically.

Conclusion

The application of the mining manipulator BMU 01 in concrete operational conditions in the mine, it will provide a high productivity by repair wagons, saving the repairing staff and release the tedious and heavy manual work.

It is possible that new way by manipulators and robots in the mines (similarly like in machinery) for future will be going to the robots of higher generation. By this way in the future trough the robots abilities we have to cover more complexed mining technologies, where the miner by his physical and psychical condition will be not able to do it. But in the same time by the mine manipulators will be the way and their properties concerning their high productivity and the possibility for them to work in the surrounding where the man is not able to work.

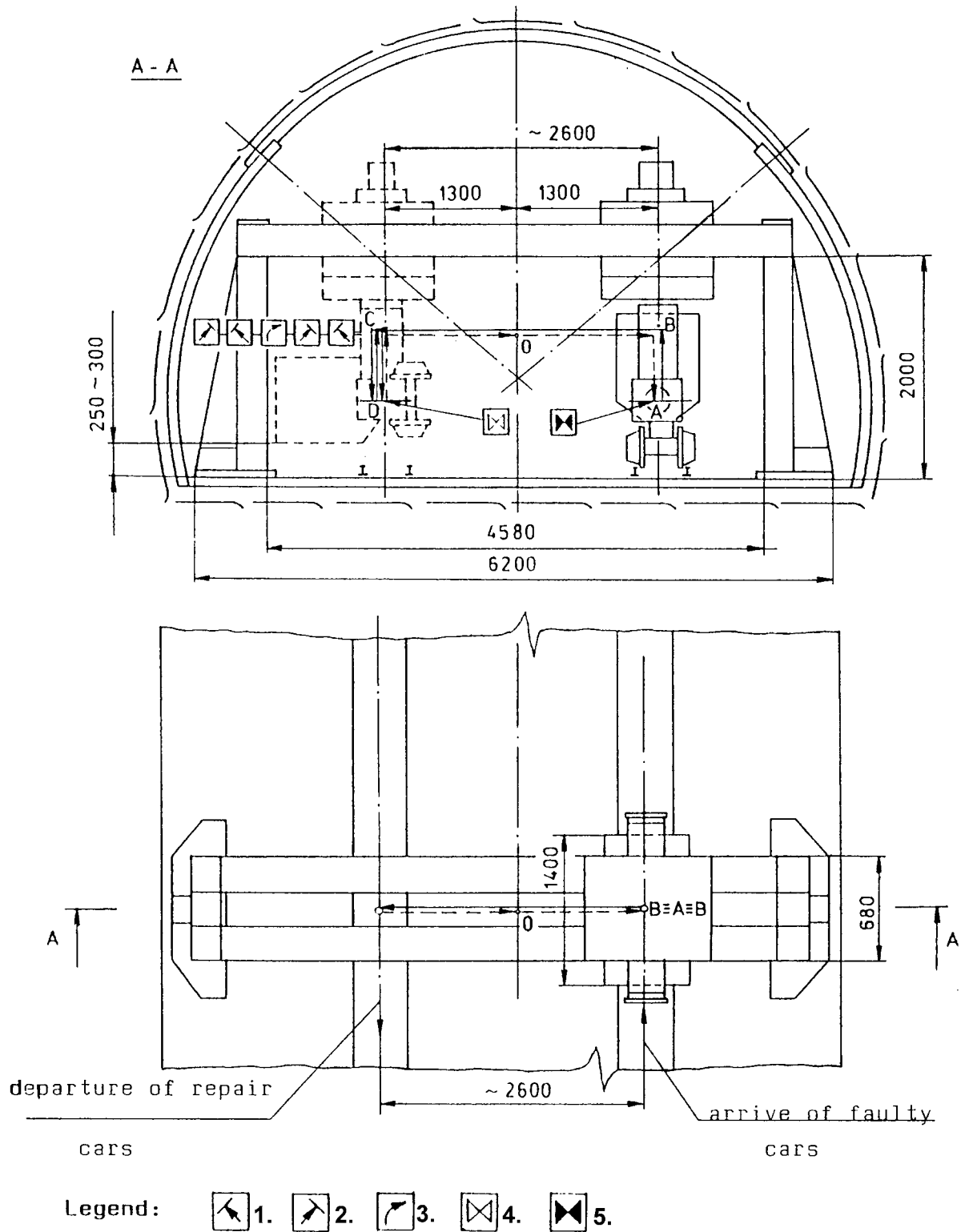


Fig.1. Situation of manipulation with the cars in the mine. 1-tip to the left, 2-tip to the right, 3-revolve to the right, 4-release, 5-chatching.

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