

ADAPTING 2K-52MU CUTTING AND LOADING MACHINE TO TR-5 SCRAPER CONVEYER

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Abstract: The necessity of mechanization of coal extraction in Jiu Valley mines, in the conditions of the present economic crisis, involved the adaptation of the existing equipments to the new conditions of reequipping of certain faces. Thus, within the program of reequipping of a longwall in Lonea Mine, the adaptation of 2K-52MU cutting and loading machine to TR-5 scraper conveyer was required. The main problem of adaptation of the two equipments was in the design and development of systems for affixing the ends of the feeding gear chain of the machine to the driving and returning stations of the TR-5 scraper conveyer. In solving this problem, the focus was on ensuring for all the elements of the attaching system of the ends of the machine chain to resist to the machine's maximum haulage force of 250 kN, and this strain not to be transmitted to the metal structure of the stations and be taken over by the hydraulic prop of anchorage of the conveyer station

Keywords: adaptation, cutting and loading machine, scraper conveyer

1. Introduction

To adapt the existing equipments in view of reequipping the faces, one should be deeply familiar with the structure and technical characteristics of the equipments that are used and of the way they are correlated with the mining method, the geological-mining conditions specific to the layer exploited, and with observing the occupational health and safety norms.

By the implementation of a longwall reequipping program in Lonea Mine in the fourth trimester 2013, the classical method of extraction with a productivity of 6,8 ton/job was abandoned in favor of longwall extraction method with individual support and cut with a machine with an estimated productivity of 12 ton/job. A technical documentation was required to be drawn up in this sense, regarding the adaptation of the affixing program for the 2K-52MU machine to TR-5 scraper conveyer stations. In order to see the correlation of the equipments, an analysis of the framework extraction method was made for longwalls with cutting and loading machines. Fig. 1 shows the working stages for a maximum 3,2 m high longwall and 1,8 m high cut with the machine, as it follows:

I – machine in the bay; II – cutting the first strip; III – manual fixing of the place for mounting the articulated beam; IV – machine advance in the bay and mounting of the fourth prop; V – cutting the second strip; VI – manual cleaning up of the face and machine advance in the bay; VII – moving the back prop under the first beam; VIII – ripping of the back prop and beam.

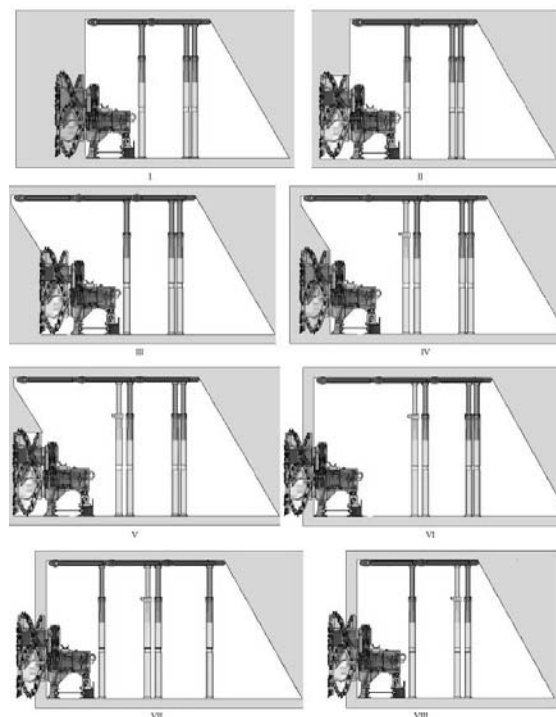


Fig. 1. Longwall extraction method with individual support and machine cutting

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From the above, it results that an analysis of economic efficiency should be made, regarding the correlation of the longwall height with the cutting height of the machine, with the geological mining conditions and the occupational health and safety norms. The price of the 2K-52MU machine, recovered from cassation should be considered, scrap iron – 2500 Euro, rehabilitated and put to operate with maximum 5000 Euro.

The technical characteristics of the 2K-52MU machine were not correlated with those of the TR-5 scraper conveyor, especially considering that the latter had not been designed for faces, and they had been manufactured by different companies in different countries. The two equipments are nevertheless compatible, at least from the following points of view:

- More than half of the theoretical cutting capacity of the machine, which is not achieved in practice due to the correlation of the advance speed with the geological-mining conditions, can be handled by the scraper conveyor;
- Size-wise, the machine can be mounted on the conveyor by adopting suitable modifications, adapting TR-5 stations to chutes, TR-6 with the use of TR-7 laterals, and modification of machine shoes without diminishing the characteristics of their resistance;
- The conveyor's robust design supports the approx. 12 ... 14 ton mass of the machine;

The design of the scraper conveyor allows coal to be loaded in good conditions by the auger drums.

The main lack of correlation between the two equipments consists in the fact that the actuating and return stations for the TR-5 conveyor are not foreseen with attaching hangers/plates of the affixing device of the machine haulage chain end.

2. Affixing system to the actuating station

Fig. 2 shows the design solution for the positioning of the attachment system of the end of the chain calibrated with 26x92 links of the 2K-52MU machine advance mechanism, reference point 2, in the metal construction of the actuating station, reference point 1.

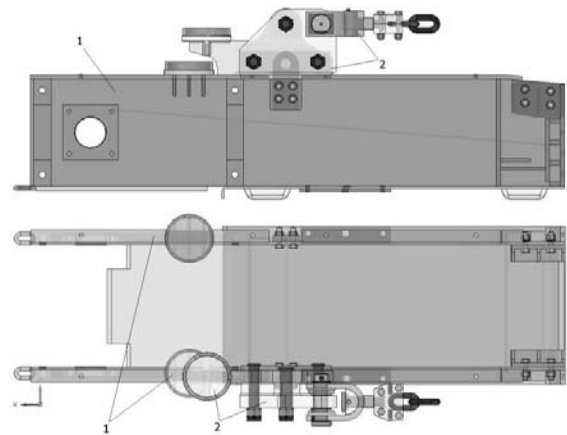


Fig. 2. Movement of the affixing system on the actuating station [3]

The design solution of the affixing system is shown in Fig. 3, which is made up of 1 – hanger fixed on the station; 2 – lateral connecting plate; 3 – lateral blocking plate; 4 – blocking bolt $\Phi 50$; 5 – blocking bolt $\Phi 60$; 6 – articulation bolt $\Phi 60$; 7 – device hanger; 8 – haulage rod; 9 – wear ring; 10 – wear ring support; 11 – chain fixing strap; 12 – centering pin; 13 – chain calibrate with 26x92 links; 14 – M20x100 screw; 15 – M10 screw for greasing; 16 – distance ring; 17 – M42 low washer; 18 – M42 washer; 19 – M24x100 screw.

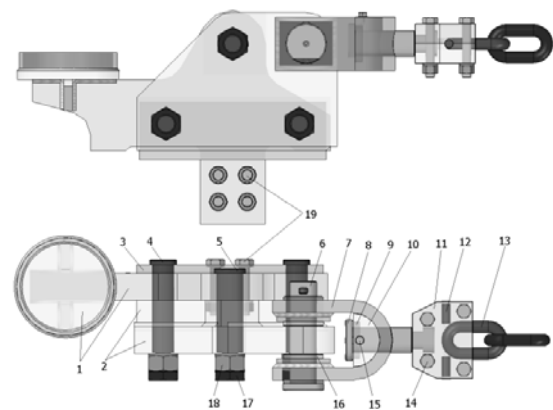


Fig. 3. Design solution for the affixing system of the chain end to the TR-5 actuating station[3]

The affixing system for the chain end to the TR-5 actuating station shows the following design improvements:

- the hanger fixed to the station, instead of the lifting hanger, leans on the framework of the station by two distanced shoes and has its own support for the SVJ station anchoring hydraulic prop, which improves stability of hanger and the way forces are transmitted to the station;

- overlapping the prop supports avoids the error possibility in placing the anchoring prop and allows interchangeability of the actuating station;
- parallel positioning of the lateral linking plate, reference point 2(Fig. 3), and rigid fixing on the hanger through the three bolts $\Phi 50$, reference point 4, and $\Phi 60$, reference point 5, made a movement outward the chain axis by 120 mm, which improved the movement of the machine on the conveyer in the area of the actuation station;
- the distance between the wings of the device hanger, reference point 7, by inside welding of the of two 20 mm thick attachments plates, which improved the strain on the articulation bolt, reference point 6;
- axial rolling contact bearing with balls 51112 was replaced with a wear ring of cast iron or bronze, reference point 9, its part being to take over the twist of the chain, and a screw was provided, reference point 15, for greasing the contact area between the wear ring and the ring support, reference point 10;
- transversal pins were provided, reference point 12, to center the two bridles in view of improving the haulage force transmission between the haulage rod, reference point 8, and the chain link, reference point 13;
- only 20 mm and 60 mm thick sheets were used, which were in stock in Lonea Mine;

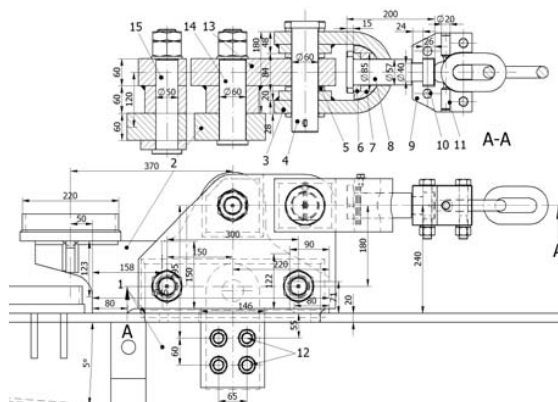


Fig. 4. Calculation model for the connection system at the actuation station[3]

Based on the design solution in Fig. 3, the calculation model was drawn up, with constructive dimensions in view of dimensional verification of its elements given in Fig. 4, where: 1 – partition of

actuation station; 2 – hanger fixed to the station; 3 – device hanger; 4 – articulation bolt $\Phi 60 \times 270$; 5 – distance ring; 6 – wear ring; 8 – haulage rod $\Phi 57 \times 200$; 9 – bridle; 10 - M20x100 screw; 11 – centering pin $\Phi 20 \times 45$; 12 - M24x100 screw; 13 – lateral connecting plate; 14 – blocking bolt $\Phi 60$; 15 – blocking bolt $\Phi 50$.

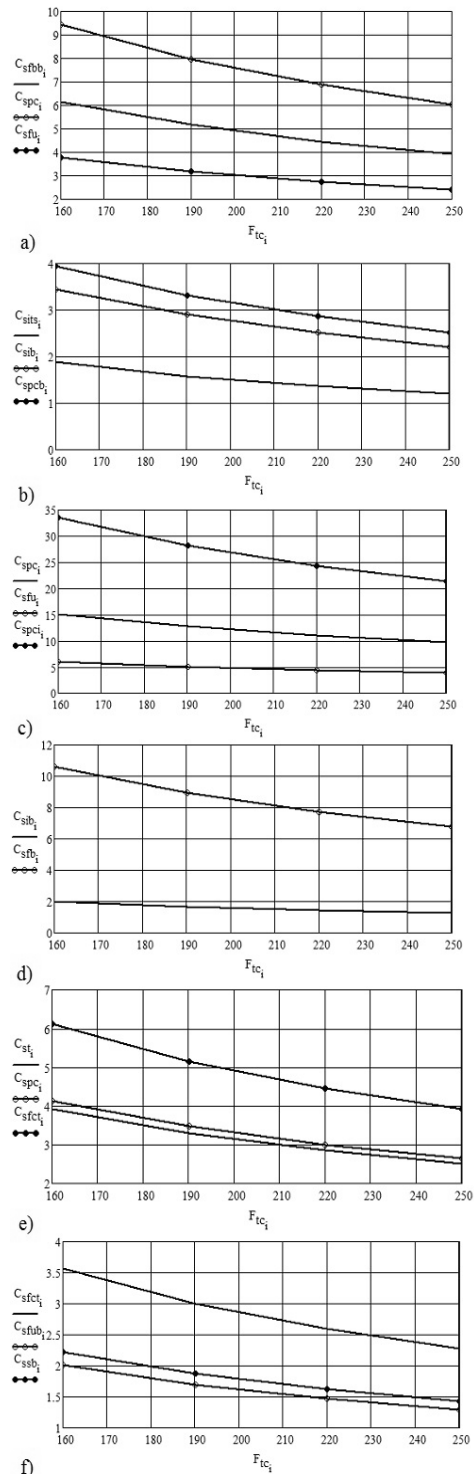


Fig. 5. Variation of safety coefficients of connection system to the anchoring station[3]

Based on the calculation model in Fig. 4, a calculation breviary was drawn up in Math CAD for the variation of the machine's haulage force F_{tc} between 160 and 250 kN, and the value of safety coefficients are graphically shown in Fig. 5 for the following constructive elements

- lateral connecting plate(Fig. 5a);
 - hanger fixed to the station, 2, (Fig. 5b);
 - hanger of the connecting device, 3,(Fig. 5c);
 - articulation bolt $\Phi 60 \times 245$, 4, (Fig. 5d);
 - haulage rod $\Phi 57 \times 200$, 8, (Fig. 5e);
 - attachment bridle for the chain link, 9, (Fig. 5f).
- Safety coefficients resulted by relating to mechanical characteristics of OL 37, 210 N/mm² flow limit for sheets and improved OLC 45, 500 N/mm² flow limit for bolts. The lowest values are with bending for bolts, reference point 4, $C_{sib}=1,28$, and with shear of the fixing bridle hanger of the chain, reference point 9, $C_{sfib}=1,29$, these values can be amplified 1,7 times, if the relating is made at tear resistance.

Based on the documentation of execution the system of connection of the machine chain to the actuating station was carried out in Lonea Mine, Fig. 6

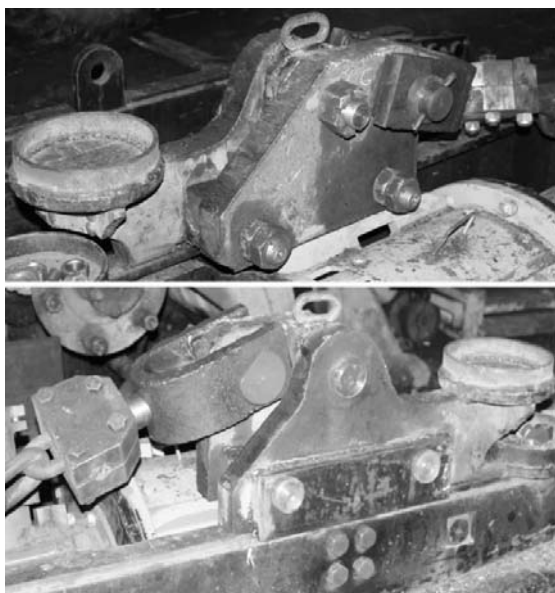


Fig. 6. Chain connecting system to the actuating station carried out in Lonea Mine[3]

3. Connecting system to the return station

Fig. 7 shows the constructive positioning solution of the connecting system of the chain end calibrated with 26x92 links of the advance

mechanism of the 2K-52MY machine, reference point 2, to the metal structure of the return station, reference point 1.

Fig. 8 shows the constructive solution of the connecting system, made up of: 1 – hanger fixed to the station; 2 – articulation bolt $\Phi 60$; 3 – chain connecting device; 4 - M30x100 screw; 5 – M30x200 screw.

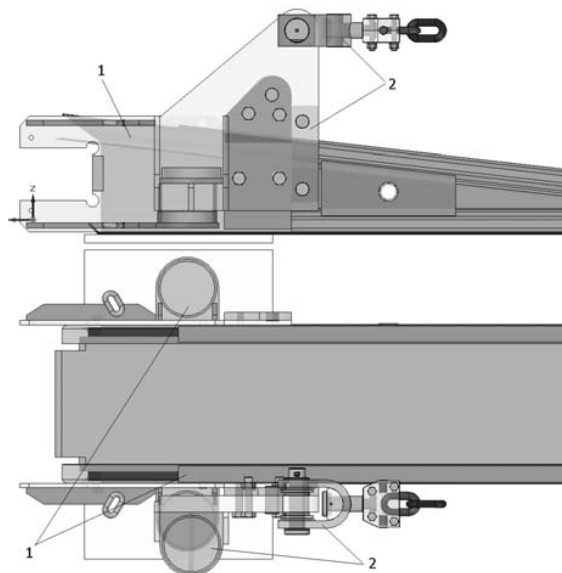


Fig. 7. Connecting system positioning to the return station[3]

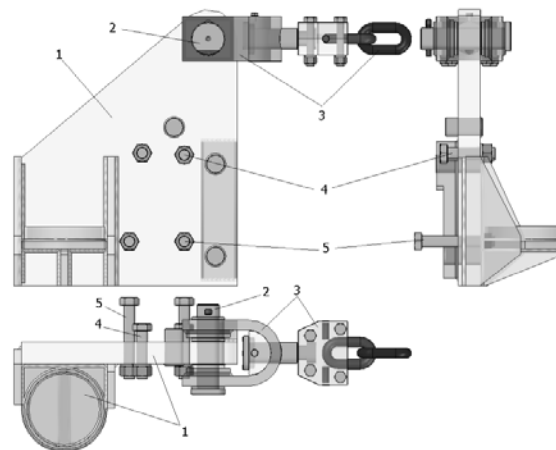


Fig. 8. Design solution of the chain end connecting system to the TR-5 return station [3]

The chain end connecting system to the TR-5 return station shows the following design improvements:

- the hanger fixed to the station, to the lifting bolt by a bolt $\Phi 50$ and four screws M30, has in front a rigid threshold by two bolts $\Phi 50$, blocking the turning of the hanger against the station partition

- on the outside of the hanger the support for the station anchoring hydraulic prop SVJ was placed, in a welded structure, solidier than the one on the return station;
- by overlapping the prop supports, the error of wrong positioning of the anchoring prop can be avoided;
- in case of changing the return station, part of the gussets for hardening the prop support should be discharged with oxyacetylene flame, on the return station, on the hanger's mounting part, and the two holes for screws M30x100 should be made in the lifting hanger.

Based on the design solution in Fig. 8, the calculation model with constructive dimensions in view of dimensional verification of its elements, shown in Fig. 9, was drawn up, where: 1 – station lifting hanger ; 2 – connecting system hanger; 3 – bolt $\Phi 50 \times 100$; 4 - bolt $\Phi 50 \times 120$; 5 - screw M30x100; 6 – chain connecting device.

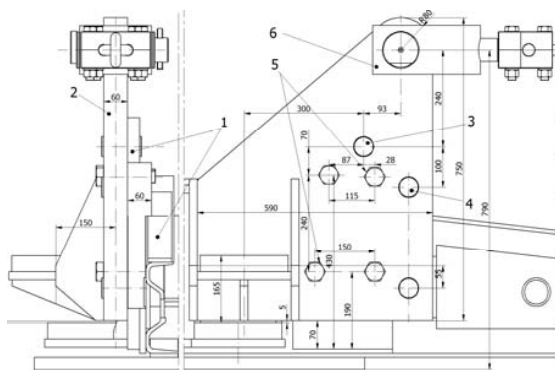


Fig. 9. Calculation model for connecting system to return station[3]

Based on the calculation model in Fig. 9, a calculation breviary in MathCAD was drawn up for F_{tc} haulage force variation of the machine, between 160 and 250 kN, and the values of the safety coefficients are graphically shown in Fig. 10 for the following design elements:

- assembling by bolt $\Phi 50 \times 80$, 4, and screws M30x100, 5, of the hanger on the station partition, (Fig. 10a);
- station lifting hanger, 1, (fig. 10b).

Since the values of sliding safety coefficient Csa_i are low, an additional blocking of the hanger was carried out against the return station lifting hanger by bolts $\Phi 50 \times 120$, reference point 4, and a vertical rule.

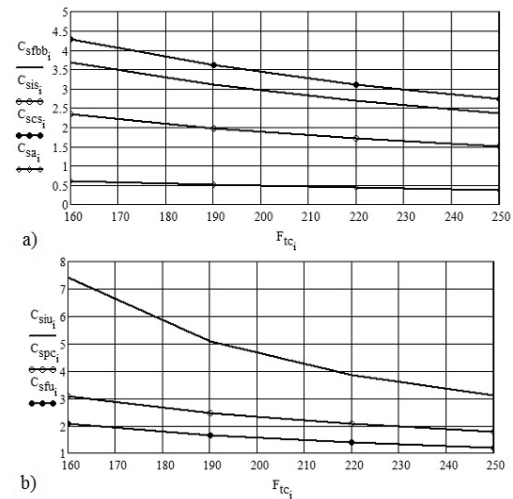


Fig. 10. Safety coefficients variation of the connecting system to the return station[3]

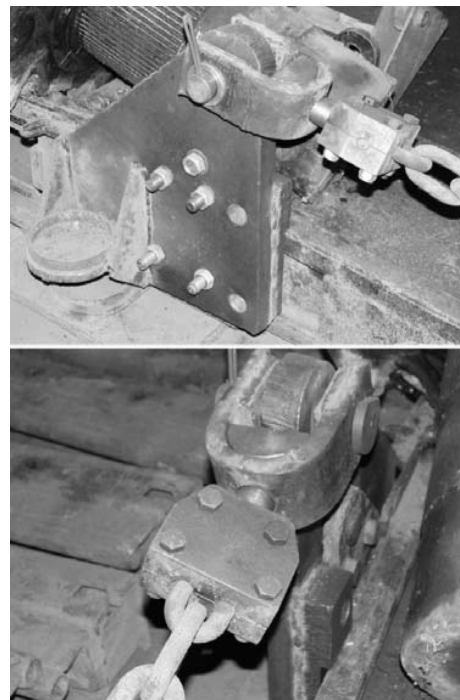


Fig. 11. Connecting system of the chain to the return station carried out in Lonea Mine[3]

Based on the execution documents, a connecting system of the machine chain to the return station was carried out in Lonea Mine fig. 11.

To check the way of positioning and movement of the 2K-52MU machine on the conveyer carried out of TR-5 stations, TR-5 chutes and lateral of TR-7A , the assembly in Fig. 12 was carried out in Lonea Mine Shops, with new systems of connecting the chain ends to the machines' advance mechanism.

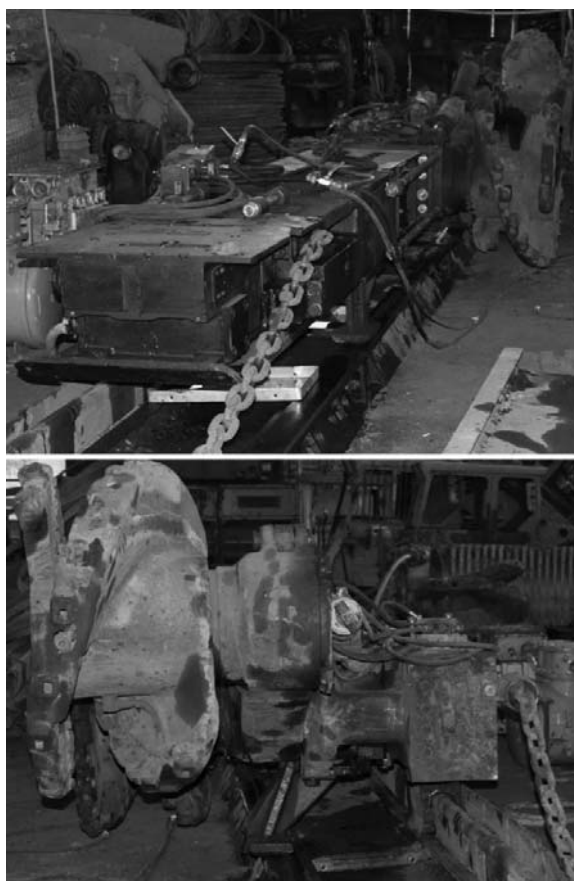


Fig. 12. *Mounting the machine to the conveyer[3]*

4. Conclusions

Even if the cutting height of the machine is not correlated with the height of the face, an improvement of work conditions results for a minimum reequipping of the face.

By adapting the 2K-52MU machine to a hybrid scraper conveyer, TR-5 stations, TR-6 chutes and TR-7A laterals, experience was gained in the use of these equipments in the exploitation of longwalls of individual support ant machine cut.

In an endeavor to move the machine on the conveyer, the connecting systems of the chain ends of the advance mechanism to the conveyer stations were checked.

The information obtained as a result of face reequipping in Lonea Mine, with the advantages and disadvantages of the method application, will allow in the future to achieve an optimization of the equipments correlation in a shortwall working.

References

1. Dalban, C., ș.a.

Metallic Constructions, Editura Didactică și Pedagogică, București, 1983.

2. Găfițeanu, M. ș.a.

Machine pieces, vol. I and II, Editura Tehnică, București, 1981 și 1983.

3. * * *

Technical documentation on implementing the connection system of the 2K-52 MY combine to the TR-5 transporter stations and checking the combine stability on the transporter, contract 713/ 26.08.2013, E.M. Lonea.