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System for Secondary Cleaning of the Belt of a Conveyor with Two-Drum Drive

Neli Stefanova, Matei Mateev

University of Mining and Geology "St. Ivan Rilski", 1700 Sofia

ABSTRACT. The paper treats a system for secondary cleaning of the belt of a conveyor with two-drum drive consisting of a cleaning device and units providing its assembly, adjustment, operation and maintenance.

СИСТЕМА ЗА ВТОРИЧНО ПОЧИСТВАНЕ НА ПЛАТНОТО НА ГЛТ С ДВУБАРАБАННО ЗАДВИЖВАНЕ
РЕЗЮМЕ. Докладът третира система за вторично почистване на ГЛТ с двубарабанно задвижване, състояща се от чистачно устройство и възли, осигуряващи монтажа, регулировката, експлоатацията и поддръжката му.

The scraping cleaning devices for conveyor belts removing the stuck pollutions in tangential direction (thick scrapers, sections, cords, threads of brushes, liquid or gas jets) are thought to be quite well applicable in mining industry because of their design and operational features, which answer the conflicting demands for high cleaning efficiency as: minimal belt wear, selection of the device parameters with a view an optimal operating duty to be provided, adjustment without the conveyor to be obligatory stopped, possibility for operation of the latter in case of the cleaning device failure, etc. The prospects of their successful application in the branch are connected with the possibilities for modernization and improvement by utilization of different in shape, design, material and pliability in the direction of the belt holder as well as of self-adjusting (automatic) pressing devices. The possibilities for the cleaning blades to be manufactured from different in properties materials (hard and wear –resistant steel plates, polyurethane, hard rubber, other types of special polymers, metal ceramics reinforcement) depending on the design features and operational conditions of the belt conveyor itself should not be neglected as well.

A good effect could be achieved at the two-stage diagram for the conveyor belt cleaning. Usually the first stage (primary cleaning) aims at the cleaning of about 80% of the whole pollution (Тарасов, 1993; Стефанова, Матеев, 2003; Стефанова, Матеев, 2004).

The so called secondary cleaning provides the removal of that permanently stuck to the belt material that has been left after the primary stage.

The necessity of secondary belt cleaning devices application could be grounded as follows:

1. During the operational process the primary belt cleaning device effectiveness gradually decreases because of its actuator wear;
2. Permanently stuck (i.e. left after the primary cleaning) material coat with minimal thickness of about 0.15mm could cause sprinkling of tones of material in the under conveyor area and its removal is connected with considerable expenditures and specialized engineering use (Лившиц, 1974).

It should be taken in consideration that the cleaning stage determines to a great extent the type of the material for the cleaning blades manufacture.

The choice of the belt cleaning devices should be in conformity with the concrete company features (mining conditions, physical-mechanical properties of the material subjected to transportation, belt conveyor maintenance and repairs organization, maintenance staff qualification) and be conductive to the achievement of economic effect by the operation and maintenance costs decrease.

For cleaning of the very adhesive and abrasive clays from the overburden and the coal seam layers sticking to the belt surface of the conveyors in the opencast mines MARITZA-IZTOK has also been chosen the two-stage diagram, which is realized by:

- A primary belt cleaning device with rubber blades;
- A cleaning device with reinforced steel blades for the stuck material scraping from the deflecting drum mantle.

In order to avoid typical of this secondary belt cleaning method disadvantages as:

1. Increased energy consumption (for the material compaction on the drum surface by the tightly stretched belt, which partially covers the latter; for the already compacted by the belt material);
2. Fast blades wear – especially of those disposed at the drum central part;
3. Change for the worse of the drum cleaning and consequently – appearance of transverse stresses in the belt due to its flexure around the tubby compacted material on the deflecting and tightening drums;
4. Material sprinkling along the whole conveyor layout – a result from the unsatisfactory cleaning,

a complete system for secondary belt cleaning has been developed, tested and introduced in practice by the designer's team. The design and operational features of the belt conveyors operating in the conditions of opencast mines MARITZA-IZTOK as:

- High motion speed;
- Different degree of material adherence to the belt surface;

- Presence of metal clamps and rivets on the belt – a result from emergency repairs (consequence of the belt small parts splitting);
- High abrasiveness of the transported material,

have been taken into account at the system development.

As a fundamental element of the system is regarded the unit BELT CLEANING DEVICE (BCD) consisting of a bearing beam, blade holder with built in damping elements and the cleaning blades (Стефанова, Матеев, 2004). Its general view is shown in fig. 1. The device design features let the metal clamps and rivets pass and also provide simplified operation, maintenance, adjustment and direct mounting to the belt conveyor frame.

Fig. 1.

During the device development it is specified that for the operational tests and further use it has to be mounted to the double drum drive head of a belt conveyor 1800 (BC - 1800), characterized by layout length 1014m, belt motion speed 5,25 m/s and aggregate installed capacity of the three driving electric motors 1680kW.

After a thorough inspection of the drive heads of the belt conveyors 1800 operating in the opencast mine TROJANOVO-1 engineering documentation for cleaning system in two basic modifications, according to its position toward the driving drums, is developed:

1. Upper cleaning system (Fig. 2-c);

- Typical of the system is that the cleaning device is disposed directly after the conveyor upper driving drum, which diameter is 1630mm and length – 2100mm. The actuator disposal is provided by two articulated arms connected with the support beam of the end section of the BC – 1800 by the two specially developed for that purpose units SUSPENSION. The blades lifting and initial compression to the subjected to cleaning belt surface are accomplished by two steel ropes. Each of them has one end connected to the respective articulated arm (left or right) and other - to an anchor device. The latter, on its part is fixed to the conveyor transfer bin upper edge. The alteration in the ropes position (from horizontal to vertical) as well as the tensioning adjustment is provided by additional technical means. Units for prevention the rope from torsion or distortion at its tensioning adjustment are provided.

2. Down cleaning system (Fig. 2-a, b).

It is characterized by the cleaning device disposal in front of the second (down) conveyor driving drum.

Both of the diagrams provide possibility for:

- Disposal of the belt cleaning device in proximity of the line where the tightly stretched and set upright belt restores, respectively discontinues its contact with the second (i. e. down) or the first (i. e. upper) conveyor driving drum;
- Adjustment of this proximity, i. e. of the distance between the line, in which the belt cleaning device blades contact with the operational belt surface and that in which the latter is tangential to the cylindrical surface of the respective driving drum in priory determined limits, optimal, in terms of providing good effectiveness.

The modifications are consistent with the real conveyor belt position in the cleaning zone, which is at an angle of 23 degrees toward the horizon. Possibility for adjustment of the cleaning blades position in the zone disposed in the close proximity of the contact line of the belt with the driving drum is provided.

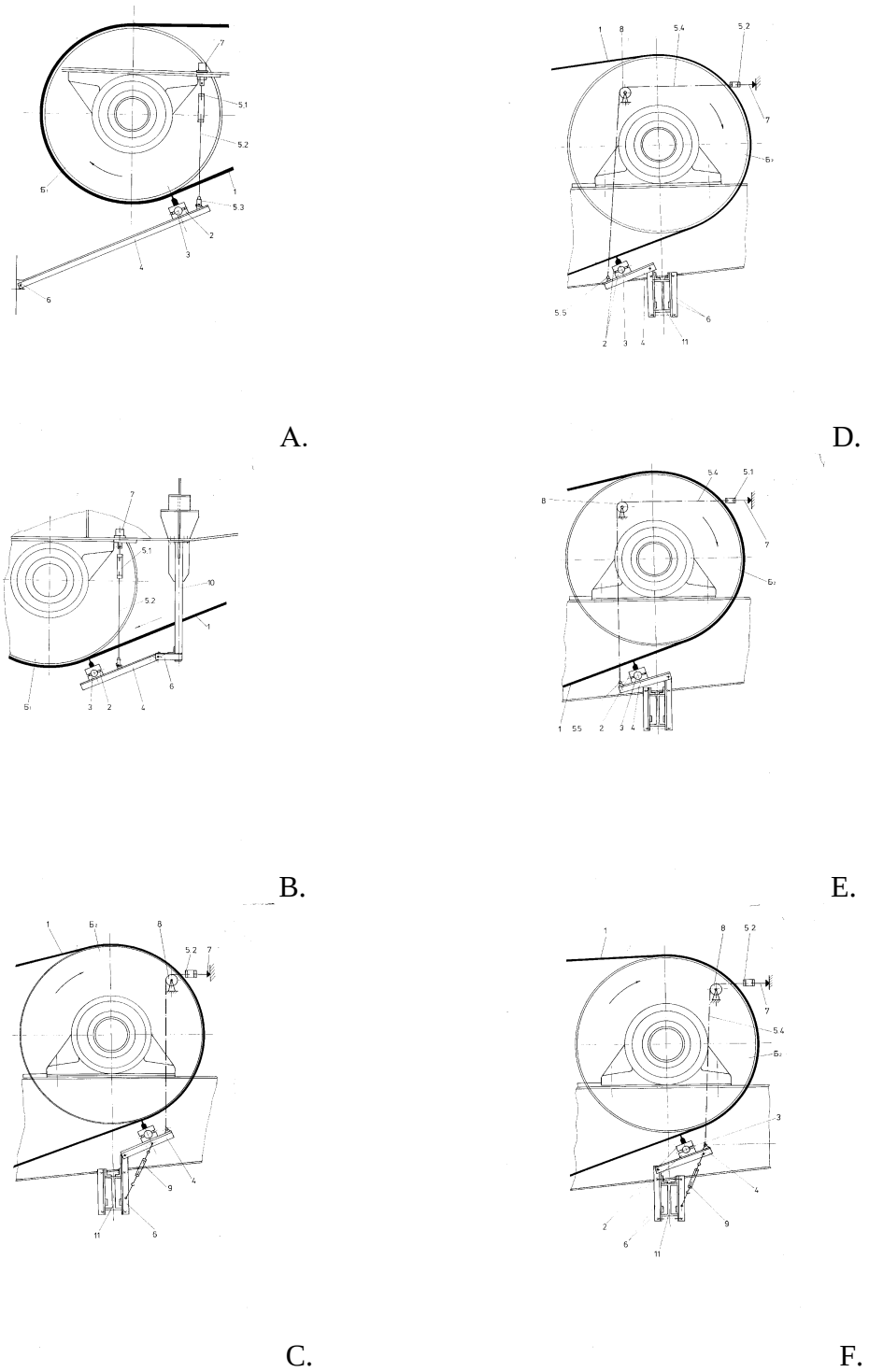

Fig. 2. $Б_1$ – down driving drum; $Б_2$ – upper driving drum; 1 – conveyor belt; 2 – two-jaw fixing device; 3 – actuator; 4 – articulated arm; 5 – tensioning device; 5.1 – clamp; 5.2 – stud; 5.3 – articulated joint; 5.4 – steel rope; 5.5 – ring-bolt; 6 – suspension; deflecting device; 8 – pulley; 9 – adjustable fixing drawbar; 10 – support; 11 – under gear supporting beam.

The differences between the two systems are shown in the design of the units for suspension and these intended for adjustment of the disposal and compression force of the actuator to the belt.

An analysis of the advantages and disadvantages has been made at the both of diagrams development:

1. Upper cleaning system.

1.1. Advantages.

- The tensioning clamps adjusting the cleaning blades compression to the belt are brought out at a comfortable, accessible place for the maintenance staff (i. e. they are disposed by the operator's cabin both sides);
- The actuators disposal (directly after the upper driving drum) creates preconditions for the material removed at the cleaning to be loaded on the strand of the accepting conveyor (in case of absence of a sleeve from conveyor belt) or on the platform (in presence of such a sleeve).

Fig. 3.

Fig. 4.

1.2. Disadvantages.

- The system fundamental units mounting to the support beam of the end section of the belt conveyor BC – 1800 necessitates the removal or displacement of the curtain from worn belt in front of the conveyor transfer bin;
- The mounting, dismantling and inspection of the belt cleaning device actuator requires a comparatively complex operation providing descent of the cleaning device to the end downward position to be carried down. Furthermore, it is necessary the conveyor way to be stopped because the maintenance staff, which is doing the operation could be located on the previous conveyor only;
- At the conveyor operation, the cleaning device blades are in a dangerous, inaccessible zone for the maintenance staff, so their condition could be judged only by indirect signs, such as the steel rope strain, etc.

2. Down cleaning system.

2.1 Advantages.

- The actuator disposal (directly before the down driving drum) provides accumulation of the material removed at the cleaning in the same depot (pile), where goes that scraped from the deflecting drum operational surface (Стефанова, Матеев, 2004). Furthermore, no changes in the technology of the material machinery removal from the depot are necessary;
- The mounting, dismantling and inspection of the cleaning elements could be realized from places safe and comfortable for the maintaining staff, such as the driving head platforms, i. e. the surface on which it's caterpillar drive is moves. At that, there is no need the conveyor to be obligatory stopped at the operations realization.

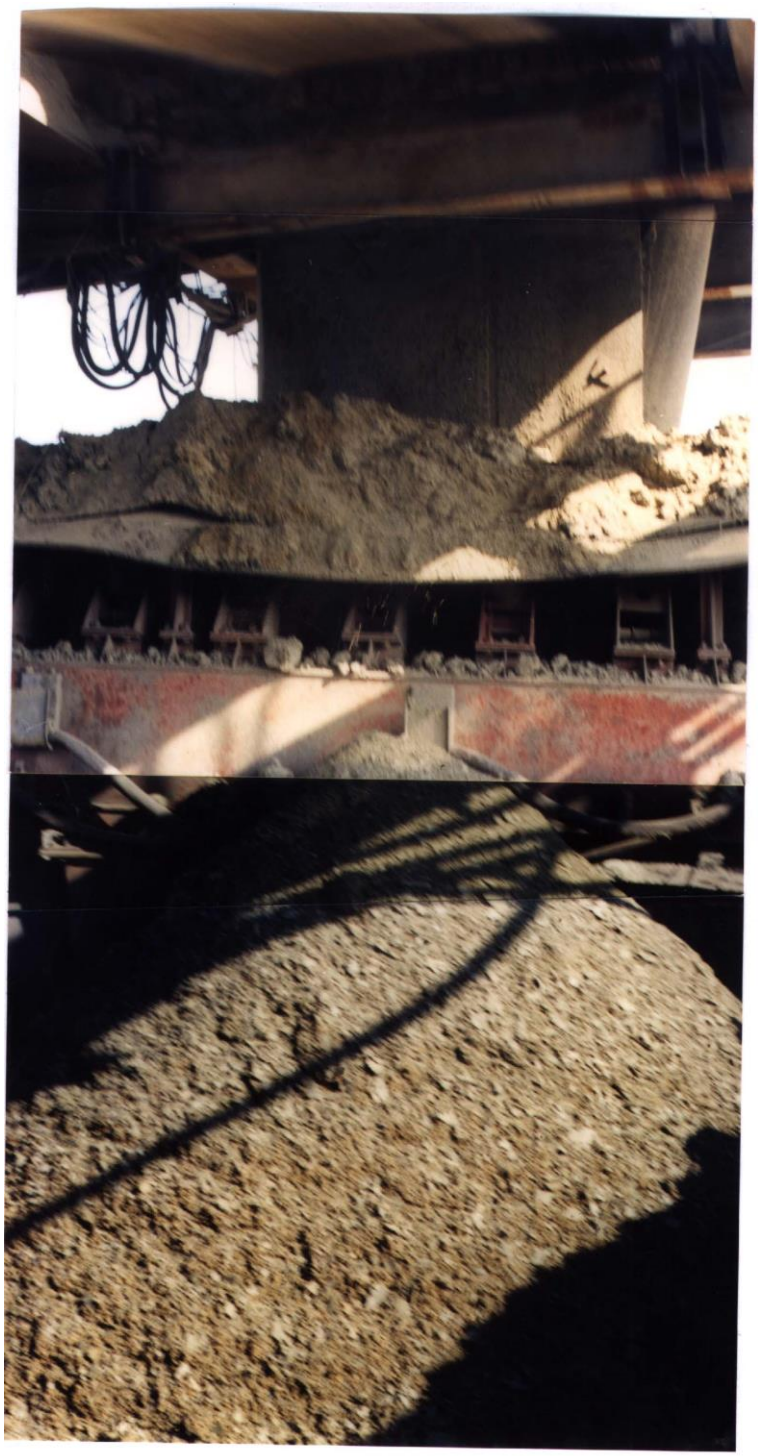

Fig. 5.

2.2 Disadvantages.

- Comparatively low disposal of the SUSPENSION unit, which makes the two articulated arms vulnerable in case of wrong maneuvers of the load-haul-dump machines raking away the pile of the scraped stuck material.

On the basis of the analysis results is determined the manufacture of the upper cleaning device (Fig. 2-c) as well as further operational tests for:

- Prove the system serviceability;
- Determination of the belt cleaning device effectiveness and reliability;
- Determination of the necessity of possible improvement not only of the entire system but of its mechanical diagram and fundamental components as well. Additional system modifications, allowing introduction of alterations by minimum changes of its elements have been developed in case of such a necessity (Fig. 2-d,e,f);
- Introduction of the system design features and the requirements of its adjustment and maintenance to the opencast mine technical staff.

Fig.6.

The upper system for secondary belt cleaning had been mounted and prepared for operational tests in the belt conveyor BC – 1800 (numbered as 1331) driving head on 01. 04. 2004. Up to the 30. 05. 2004 it operated together with another cleaning device (BCD - 1) and in the period 30. 05. – 30. 06. 2004 - with the BCD shown in Fig.1.

During the operational tests the system and the BCD have totally saved their initial serviceability (there are no damaged or worn out sectional blades, tensioning device self-loosening, etc.). It is reflected by a written statement, which recommends their further introduction in belt conveyors of the mentioned type, operating in the opencast mines MARITZA – IZTOK.

The general view of the cleaning device mounted in operational position is shown in Fig. 3. The system operational effectiveness is illustrated by the stage of belt cleaning from muddy mine body (overburden) with high abrasiveness (Fig. 4) and, by the quantity of the stuck material scraped in a shift (Fig. 5).

It is determined that due to the tested system for secondary belt cleaning and respectively to the cleaning device effective operation the device for the deflecting drum mantle cleaning operates in eased duty (Fig. 6).

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