Safety Features for Reduction of Failure in Stacker cum Reclaimer for Thermal Power Plant

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Abstract: ***This paper is a study with the actual situation of thermal power plant for increasing the safety measure by which the failure rate of the components of stacker cum reclaimer in the thermal power plant, used for coal handling can be reduced. This study is made to reduce the chances of failure in the components of a stacker cum reclaimer by using several safety measures and installing various safety devices.***

Keywords: Thermal power plant, coal handling system, stacker cum reclaimer, safety devices.

1. Introduction

The machine system operates under highly variable conditions. For this reason, their component parts are subjected to variable load. It is required that each machine system has a certain operational safety and reliability for the given life time..However, as a result of the effect of variable loads, some parts may be damaged and failure may occur. The research has been carried so as to ensure that failure does not impact on the material handling rate of coal in coal handling plant.

2. Stacker Cum Reclaimer

The stacker cum reclaimer is suitable for building stockpiles on either side of track rails and subsequently reclaiming these materials from the piles and feeding them for working with a reversible yard conveyor with provision for feeding at one end for stacking and discharging at the same end during reclaiming.

Figure 1: Stacker cum reclaimer in coal yard

3. Components

3.1 Structural Steel Work

All parts are conveniently arranged for ease of access with special attention being paid to the requirements for maintenance of machinery. To facilitate the maintenance of the various parts, it is full of web construction and adequate walkways, ladders etc are provided for convenient operation.

3.2 Bucket Wheel and Drive

The bucket wheel drive consisting of motor, (fig 1) fluid coupling, thrustor brake and gear box, mounted on a drive frame, is supported from the boom head by means of a torque arm with plain spherical bearings. The hollow output shaft of the gear box is clamped onto the bucket wheel shaft by a shrink disc element. The shaft assembly with bearings in housings is supported on the boom head structure. The drive unit and the bearing housings are adequately protected by sheet steel covers.

3.3 Boom Conveyor

The reversible boom conveyor drive is mounted on a drive frame and is supported on the revolving frame by a torque arm with plain spherical rod ends. The bearing housings supporting the discharge pulley assembly on either side are supported on sliding blocks at boom head. The movement of the bearing blocks for the purpose of adjustment of belt tension and belt changing is achieved through screwed spindles. Belt sway, pull cord and belt slip monitor switches are included for protection of the conveyor.

3.4 Boom Luffing Arrangement

The raising and lowering of the hinged bascule system and controlling it in operation, is achieved by a hydraulic system with two hydraulic cylinders. The cabin is also maintained level automatically by a hydraulic cylinder fed simultaneously from this system. The power pack also includes an independent system for actuation of the chutes etc. and is mounted on at the rear of the revolving platform.

3.5 Slewing Arrangement

The revolving superstructure of the machine is supported on a large diameter slewing bearing. An external ring gear, bolted to the revolving frame, is driven by two meshing pinions powered by two independent drive units each comprising a sq. cage motor, slip clutch, brake and planetary with bevel helical gear reducer. The slew angles are monitored by limit switches. Additional contacts in the limit switch ensure that the boom can only be slewed over the yard conveyor after it has been raised clear of it.

3.6 Intermediate Conveyor

The intermediate conveyor shall travel on the same rails as those of machine. After receiving from tripper, discharge

pulley material on the boom conveyor by a chute. The intermediate conveyor drive comprising motor, fluid coupling, brake and gear box, mounted on a drive frame, is supported by a bracket. The hollow output shaft of the gear box is clamped on the drive pulley shaft through a key-less shrink disc element.

3.7 Tripper Conveyor

The tripper raises the belt of the yard conveyor and supports it over a concave curve and discharge through guide chute onto intermediate conveyor. After passing over the discharge pulley, the belt is guided back to the yard level over bend pulleys.

4. Principles of Operation

The rail mounted stacker cum reclaimer is suitable for serving two parallel stockpiles, one on either side of the track rails. The machine is designed to operate with a yard conveyor for stacking and discharging at the same end during reclaiming i.e. a reversible one. The following modes of operation are possible:

4.1 Stacking

The material on the forward moving yard conveyor is raised by the tripper and discharged through a discharge guide chute onto an intermediate inclined conveyor which lift the material and ultimately discharges on to the boom conveyor by a chute. The boom conveyor carries the material up to its end and allows it to fall from a stockpile. The stacking operation as shown in fig 2 starts at one end of the stockpile with the boom kept low. The travel motion operates simultaneously and at the other end of the stockpile, the motor reverse. After a number of such cycles the boom is luffed up and the cycles repeated.

Figure 2: Stacking operation

4.2 Reclaiming

The machine reclaims the material from the stockpile in layers by the rotating bucket wheel swing across the pile. The material picked up by the bucket is retained and guided by the ring chute as the buckets move up. When the bucket is about 45 deg above horizontal, the material starts discharging it to the bucket wheel chute, which guides it to the boom conveyor. On reaching the end of the conveyor, the material passes through the central chute and portal chute on to the yard conveyor belt, supported on the impact table. The reclamation of the entire stockpile can be carried out either by bench-type and modular methods.

1. In the bench-type method the reclaimer starts at one end on the top bench or layer and reclaims that bench for the full length of the pile. On reaching the end of the pile the machine returns to the other end, the boom is lowered and reclaiming commences on the next lower bench.
2. The modular method is accomplished by starting at the top of the pile at one end and taking a series of cuts one bench deep end returning to the end of the pile, lowering the boom and taking the same number of cuts on the lower bench. This process is repeated up to the lowest bench thereby completing one reclaim module.

5. BELT

Conveyor belt is the most expensive but durable part of a conveyor. During working, the belt is subjected to variable loads, which makes the belt in a complex state of stress. There are several types of typical damage forms such as working surface and edges are worn, striking, tearing and peeling caused by the impact of big ore particles, belt core suffers from fatigue due to alternating bending via the idlers. The various safety features for belt are discussed:

5.1 Iron Grid

The feeder- hopper must have an iron grid at its mouth so that during transfer of coal to the belt through feeder-hopper does not impact the belt which results in wear of the belt.

5.2 Impact Idlers

The belt conveyor at the point of loading must be empowered with impact idlers (fig 3) so that they reduces the impact wear of the belt due to force produced on the belt at the time of loading.

Figure 1: Impact idlers

5.3 Interlocking Protection

The conveyor must be installed with programmed interlocking protection so that damage to the belt can be reduced. It provide sequence the of stopping of the belt conveyor, i.e., the first conveyor is stopped first, then the second one is stopped and so on. This is done to avoid damage of belt due to loaded start- up and from getting extra loaded at the time of uneven start- up.

6. Bucket Wheel and Drive

The process of direct digging by the bucket wheel excavator is realized in a combination of continual rotation of the bucket wheel in the vertical, and arrow movement in the horizontal plane. As a result of the drive performances, characteristics of the soil, and inequality of digging resistances on the buckets, the bucket wheel excavator is subject to a number of external loads. As a consequence, the vital parts of the excavator structure and driving mechanisms are exposed to variable load which, when it exceeds critical values, causes damage in the system. The safety features are:

6.1 Fluid coupling

Bucket wheel drive is provided with a fluid (fig 4) coupling for reduced load on motor, smooth acceleration, shock-free operation and peak load limitation with protection against overloading.

6.2 Electro Hydraulic Thrustor Brake

It is provided for smooth stopping of the bucket and holding it in the position during maintenance.

6.3 Electronic speed switch

It is provided on the fluid coupling to monitor output speed vis-à-vis motor speed
The bucket wheel motor is tripped in the event of its speed dropping below 95% of its rated speed due to over loading.

7. Boom Conveyor

The various safety features for boom conveyor are:

7.1 Zero Speed Switch

It is provided at the non-drive pulley to monitor the pulley and thereby the belt speed and trip the conveyor motor in the event of belt speed dropping below a preset value.

7.2 Belt Sway Switch

It is mounted on the boom on either side of the conveyor, to trip thee conveyor in the event of belt running out of line and pressing against the rollers levers of the switches.

7.3 Pull Cord Switch

It is provided on the support frame on either side of the conveyor, to permit tripping of the conveyor motion manually from the boom walkway in case of any emergency.

8. Slewing Arrangement

The safety features for slewing arrangement are:

8.1 Slip clutch

It restricts the maximum torque on slew gear and thereby prevents overloading of all components and structure.

8.2 Rotary cam limit switch

It is provided to prevent slewing over yard conveyor unless boom is sufficiently raised and also prevent excessive lowering of boom over yard conveyor.

9. Long Travel Mechanism

The various safety features are discussed below:

9.1 Travel Limit Switch

It is operated by strikers placed along the track for stopping travel at either end of pile and permits reversal.

9.2 Automatic Rail Clamp

It is provided to drifting of the machine in storm condition. Clamps are released by hydraulic cylinders which actuate limit switches to permit travel motion.

10. Conclusion

This study is made for reducing the failure of different parts of stacker cum reclaimer by using various safety features and these safety equipments maintain the stacker cum reclaimer in all operating conditions and hence helpful in reducing the failure.

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