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# AUTOMATIC LUBRICATION SYSTEM ON WINDER RAIL CAGE

**Jatin rawal[1], Pushpendra Ahirwar[2], Khemraj Beragi [3]**

*[1]Bachelor of Engineering (Final Year), Department of Mechanical Engineering, School of Engineering and Technology, Vikram University, Ujjain, M.P. India .*
*[2]Bachelor of Engineering (Final Year), Department of Mechanical Engineering, School of Engineering and Technology, Vikram University, Ujjain, M.P. India.*
*[3]Head of Mechanical Department, School of Engineering and Technology, Vikram University, Ujjain, M.P. India.*

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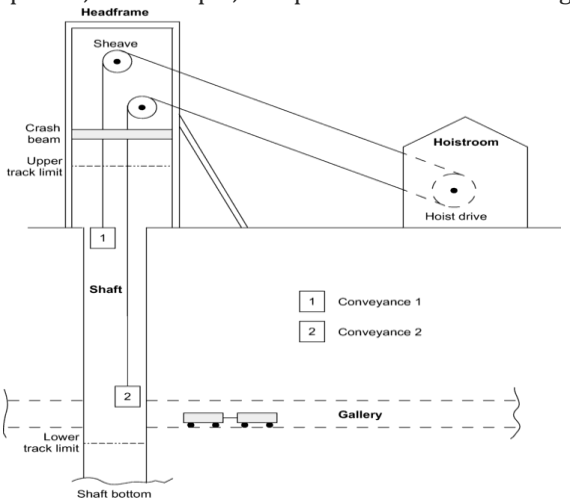
Abstract - *Mining is the extraction of valuable minerals or other geological materials from the Earth. There are thousands of mechanism used in the process of mining. Machines are made up of moving parts; therefore, they have friction in various locations. The wear and tear caused by the friction is clearly seen in machines that move at high speeds and it reduces the life of a machine. Lubrication is a crucial element in the efficiency and life-expectancy of any rotating equipment. One of the most important machine used in a underground mines is mine shaft and winder. This paper deals with the study of Automatic Lubrication System. Automatic lubrication systems provide a safer, more accurate form of machine lubrication. Manual lubrication is very time consuming so here is the idea of semi automatic lubrication in winder-rail cage. In past we have to do it manually. This study includes design and manufacturing of automatic lubrication system, which allows to do greasing at frequent interval of time and in adequate amount. This lubrication also ensures safety to machine components and reduces labour. It ensures proper lubrication to each and every part of the machine.*

***Key Words*: *Automatic lubrication system(A.L.S), life-expectancy, fully automatic and semi- automatic lubrication*.**

## 1. INTRODUCTION

The **Mining industry in India** is a major economic activity which contributes significantly to the economy of India. D.R. Khullar holds that mining in India depends on over 3,100 mines, out of which over 550 are fuel mines, over 560 are mines for metals, and over 1970 are mines for extraction of nonmetals. Mainly there are two types of mining in India – open cast mining and underground mining. Underground mining is used to extract ore from below the surface of the earth safely, economically and with as little waste as possible. The entry from the surface to an underground mine may be through a horizontal or vertical tunnel, known as an adit, shaft or decline. A mine shaft is a vertical access hole that is several meters in diameter and stretches down to the location of the ore. It is where miners, supplies, equipment, water and air are conveyed to gain access to the ore. Basically it is a door to the ore. Underground mining requires a number of different transportation systems. To effectively move miners and their equipment, for example, a dependable mine shaft cage is




necessary. A mine's success relies on the efficient operation of this component. If a serious problem occurs with the cage, conveyance activities must be suspended to ensure the safety of the miners and, when that happens, production is impeded. And lubrication is essential part of every working machine. The development of lubrication and its application in machine began in early 70's of last century. From the view of improving lubrication in recent years more and more stress is given on the constant increase in materials and lubricants performance. The lubrication can be defined as a process by which we introduce a layer of lubricant to reduce friction and reduces the wear between the two surfaces, which are in relative motion to each other. This process includes the following activities: -the cleaning of lubricants,- the checking the quantity of lubricants, - refilling lubricants, Choosing the with the correct lubrication system ensures firmness and allocates lubricants are best for a particular use. The abandonment machines will be avoided and the cost of system maintenance will be drastically reduced. Automatic lubrication system (ALS), defined as a centralized lubrication system, is a system that provides metered amounts of lubricant to multiple locations on a machine while the machine is operating. Centralized grease lubrication systems are widely used in industrial and heavy-duty mobile equipment applications to lubricate multiple points on a machine. The following is a complete overview of centralized grease systems and the

assistance they offer, the various types, matter to watch out for and tips on how to maintain them properly.

## 2. GENERAL DESCRIPTION -

### 2.1- VERTICAL SHAFT DRUM WINDER -

Vertical shaft drum winders wind people and/or materials in vertical mine shafts, using one or two ropes coiling typically onto a single drum. Drums may also be configured to use two drums for the same shaft (double drum) with a conveyance attached to each rope and drum. Drums and driving machinery are located at ground level, in a house or room, at sufficient distance to give the required fleet angle, with the rope positioned over the shaft by a headsheave. **Shaft mining** or **shaft sinking** is excavating a vertical or near-vertical tunnel from the top down, where there is initially no access to the bottom.

### 2.2- CAGE-

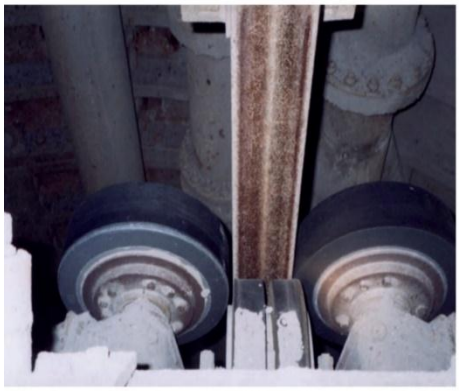
No matter what your main product may be, the safety of your workers should always be your top priority. That's why when it comes to transporting your people, materials or equipment into or out of vertical mine shafts, you should never settle for anything less than the best Mine Shaft Cage solutions. Elevator used to transport workers in a lined shaft; available in open, semienclosed or fully enclosed models with a choice of sliding, folding, or rollup doors. Cages are used in either vertical or incline mine shafts. All cages are required to contain necessary safety features. The cage acts as transport for workers, equipment, and supplies. The unit itself is connected by steel wire rope to a hoist and, together, they function much like an elevator in a tall building.

Cages vary widely, just like the mines themselves, but they share some basic characteristics. For example, a unit meant for transporting personnel needs to be covered and fitted with a gate to ensure safety. Other safety features are also included so that a cage (and, by extension, its occupants) will be protected in case of hoist failure.

The most noticeable variation is the volume and number of decks, which depends on the size of equipment they handle and the scale of operations in the mine; a mining cage may have a single, double, or triple deck.

## 3. ANALYSIS OF LOADS AND STRESSES IN STRUCTURAL ELEMENTS OF SHAFT / HOISTING -

The components of the hoisting installation include:



1 – low-torque dc motors, the inertia moment of their armature being Is;

2 – multiple rope Koepe pulley of diameter D and inertia moment IN ;

3 – Deflecting pulleys of the inertia moment IL;

4 – Skips (conveyances) of the mass q and loading capacity Q, the upper skip being loaded;

5 – Branches of hoisting ropes arranged in parallel, of the rope density γN and stiffness under tension AN EN ;

6 – Branches of tail ropes arranged in parallel, of the rope density γW and stiffness under tension AW EW

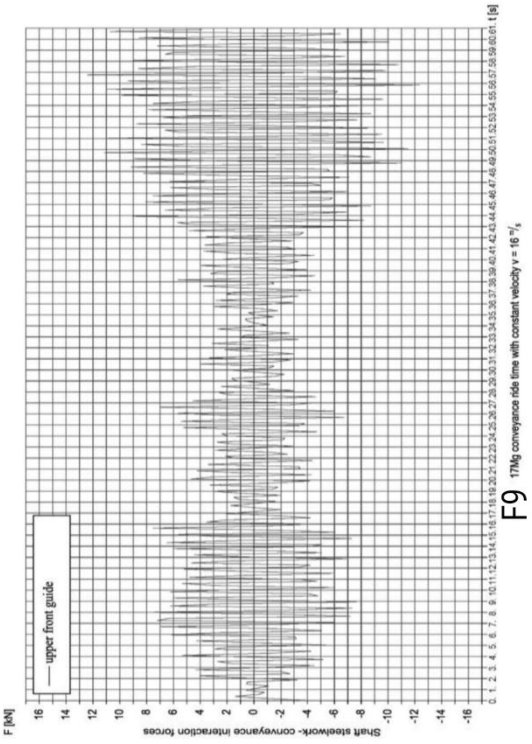
### 3.1. CONVEYANCE MODEL-

The numerical model of the conveyance (FEM 3D) was developed, inter alia, to find the interaction forces between the conveyance and shaft steelwork and to determine the state of stress and strain in selected elements of the conveyance.

Numerical models of conveyances of the lifting capacity 17 Mg are based on the technical data of real mine shaft conveyances operated in a colliery in Poland, where the guide misalignment is measured, too.

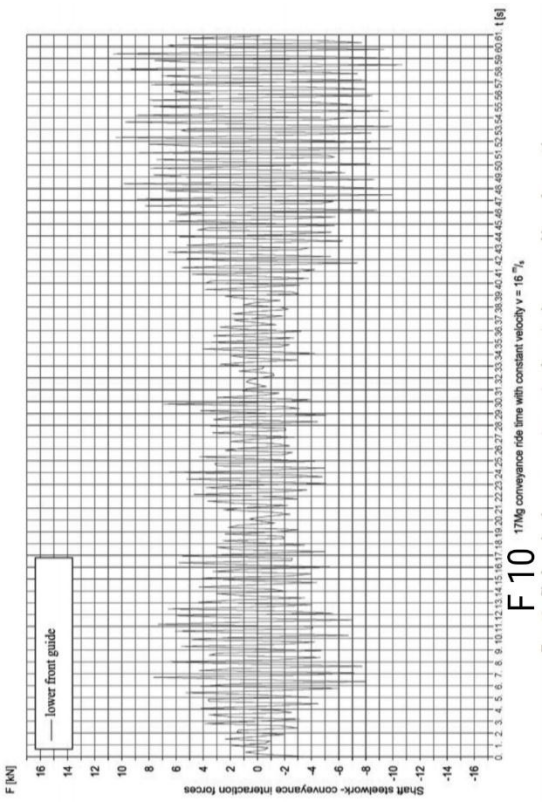
### 3.1.1. ANALYSIS OF LOADS AND STRESSES STRUCTURAL ELEMENTS-

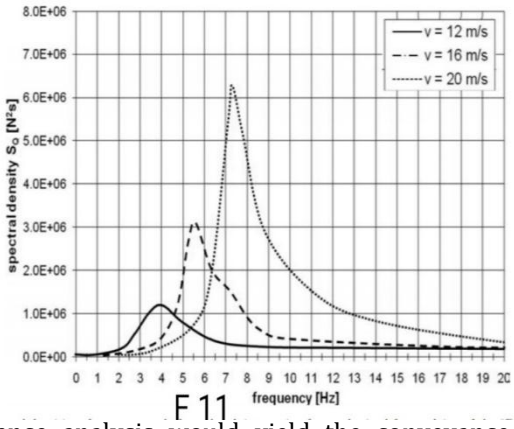
The numerical model captures the operating conditions of the mine shaft conveyance. In the vertical direction, the model is supported on the head structure (conveyance suspension) at the attachment point of the hoisting rope thimble , and at the point where tail ropes are attached to the lower frame (tail rope suspension), the time-variant force is applied equivalent to the instantaneous skip loading, due to the weight of tail ropes. Horizontal displacements of the system during the conveyance travel up and down at the fixed speed v, are induced by misalignment (irregularities) of the guide column x(t), obtained by. Measurements taken on a real plant. These irregularities impact on the guide bars at the front and on the sides. For the skip travel at the fixed speed v, it is assumed that the function governing the displacements of the lower guide bars, fixed to the bottom frame x(t+τ ), is back shifted with respect to that governing the displacement of upper guides fixed to the head structure, for the period of time τ = 1/v equal to that required by the conveyance to travel the distance l between the upper and lower guide bars.




### 3.2. STRENGTH ANALYSIS-

The numerical model of a conveyance is further utilized in the endurance analysis (the state of stress and strain) in structural elements of the system during the full hoisting cycle (loading, hoisting up from the shaft bottom, steady ride, reaching the top station, unloading, ride down of an empty skip). The




Endurance analysis would yield the conveyance-shaft steelwork interaction forces acting during the conveyance ride at the speed v. Spectral densities of those forces, are obtained, too. F 9 shows a plot of the conveyance-shaft steelwork interaction forces in the system comprising upper and lower front guide bars (F 10). Plots of conveyance-shaft steelwork interaction forces reveal the maximal values of these forces and their amplitudes. F 11 shows the plots of spectral densities of conveyance-shaft steelwork interaction forces (for three hoisting velocities v = 12, 16, 20 m/s), based on the results of the dynamic analysis of the FEM model (FEM3D).

### 4. LUBRICATION IN SHAFT -

One of the most important things an operator can do for his machinery is to make sure it is properly lubricated.

To understand what lubrication is, you first need to understand why we use it. Friction is the force that resists relative motion between two bodies in contact. If friction didn't exist, nothing would ever stop moving. We need friction to function, but there are instances where you want to be able to reduce the amount of friction present .When you rub your hands together, you create heat because of the friction between the sliding surfaces of your hands. Now imagine rubbing your hands together 3600 times a minute – your hands would be on fire!. Similar heat is generated by friction in your machinery. If the lubricant in your equipment has not been appropriately selected with standard operating temperatures, load, speed, etc., in mind, catastrophic failure may result.

In the case of mining specially we can say underground mining, the mining shaft is the most important machine. So we must take care of proper and perfect lubrication of shaft. The cage is running on the rail continuously. So it is necessary to lubricate the rail in every particular time duration and without affected the production. But in Indian mines it is done manually, which is very time consuming and high cost. Here is a model of **automatic rail cage greasing system.** Which can make the mining more economical and easer.

**5. A TYPICAL AUTOMATIC LUBRICATION SYSTEM-**

Centralized grease systems are designed principally to make the work environment safer for maintenance personnel by simplifying the process of accessing remote grease points, especially in restricted spaces, when equipment is in operation. However, the primary use is derived from the continuous application of small amounts of grease resulting in improved equipment life, due to the uniform supply of grease. Hand application is typically performed infrequently and may result in uneven amounts of grease being applied, which can lead to over greasing resulting in damaged seals and elevated bearing temperatures caused by grease churn.

**Components**

A typical system consists of controller/timer, pump w/reservoir, supply line, calculating valves, and feed lines. All automatic lubrication systems share these main components:

1. Controller/Timer –manages the pressure on the system by turning pressure supply valves on and off on the basis of either time or cycle. It can also receive signals demonstrating restricted or failed grease flow to the bearing.

2. Reservoir – provides a total quantity of grease that can be kept clean and readily available to the system.

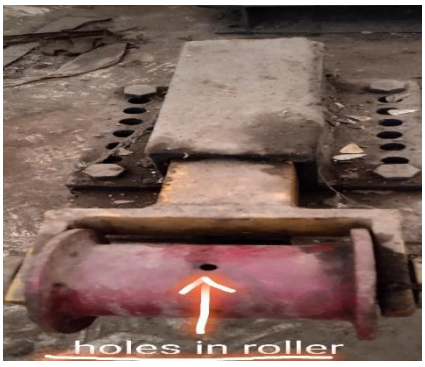
3. Pump – the flow of grease and builds up pressure in the line(s). Pump size will vary banking on the distance between the pump and the farthest injector.

4. Metering Valves/Injectors– unit that take the lubricant to the application points.

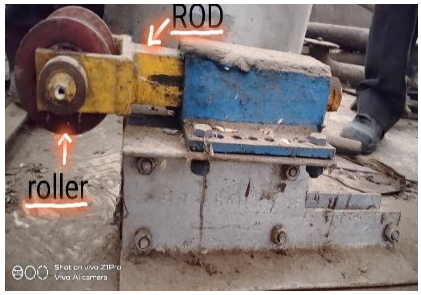
5. Feed lines - line that connects the metering valves or injectors to the application points.

**6. AUTOMATIC RAIL CAGE GREASING SYSTEM -**

**A**utomatic lubrication system is mainly used in every working machine. There are some companies which providing ALS in low cost. Here is a low cost automatic lubrication system which can be only use in rail cage. It is a small device made with a hollow roller, the roller is connected to the grease tank and also to a rod and spring mechanism, so that is can oscillate easily.




- **Working** - the best part of this machine is, the lubrication can be done while cage is operating. First of all we have to connect this set up to every lower corner of the cage. Now we can see roller is in direct contact with the rail. Grease tank is filled with full of grease. Every roller is now connected with the grease tank through the rubber pipes. Pressure is created by pumping the handle of grease tank again and again. When it reaches to the accurate pressure, we can run the cage upword or downword. The narrow holes in the roller will provide the certain amount of grease to the rail and as the cage moves the roller rotates and the grease is applied after every short distance through the narrow holes.




When the operation is done we can take it off easily. This is the most efficient lubrication system in the case of vertical shaft.

- **Benefits -**

1. All critical components are lubricated, regardless of position or ease of access.

2. Lubrication occurs while the machinery is in operation causing the lubricant to be equally distributed within the bearing and increasing the machine's availability.

3. Proper lubrication of critical components ensures safe operation of the machinery.

4. Less wear on the components means extended component life, fewer breakdowns, reduced downtime, reduced replacement costs and reduced maintenance costs.

5. Measured lubrication amounts means no wasted lubricant.

6. Safety - no climbing around machinery or inaccessible areas (gases, exhaust, confined spaces, etc.).

7. Lower energy consumption due to less friction.

8. Increased overall productivity resulting from increase in machine availability and reduction in downtime due to breakdowns or general maintenance.

## 7. CONCLUSIONS

From the Automatic Lubrication system it is concluded that the cost and man power require for the lubricating the various grease points in a cage can be eliminated. The loss of grease during greasing reduces as compared with the manual greasing. The system provides safety to the lubricating component and the operator. This system enables the greasing to the points which are not reachable to operator and down time also reduces.

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