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Fully Automatic Cage Brightening Process Equipment

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ABSTRACT

Automation greatly improves consistency of accuracy and productivity. This paper deals with the automation of Cage Brightening Process Equipment for cleaning bearings. In manual cleaning process the loading of bearings must be done manually and are cleaned in a closed container using solvents or by spraying for small bearings. The loading and unloading are done manually. To reduce the time taken for the manual process automation is done. Cage brightening refers to the cleaning process of the bearing which has cage like structure. The purpose of the cage is to hold and separate the rolling elements of the bearing. The importance of the cage brightening is to make the bearings dirt free, rust free and it also minimizes the friction losses.

The entire process consists of three systems: Mechanical system contains six station rotary transfer line, Pneumatic system consists of pneumatic supply and pneumatic controls and Electronic system. This system is very efficient for cleaning of bearings as each bearing is cleaned at three different work stations and dried by using hot air. The bearings are free from the residues and works efficiently. A bearing is a machine element that constrains the relative motion between the moving parts to only the desired motion. Cage brightening is an important process in industries because bearings require periodic maintenance to prevent premature failure.

Introduction

The major applications of this system are in manufacturing units, automobile sector, robotics and in laboratories. Bearings are highly engineered and precision made components which enable machinery to move at extremely high speeds and carry remarkable loads with ease and efficiency. They must be able to offer high precision, reliability and durability as well as ability to rotate at high speeds with minimal noise and vibrations. Maintenance of bearing is very important to improve the life of the bearings. Clean bearings will roll smoother and increases the bearing life. So, this system helps to improve the maintenance of the bearings.

This system consists of rotary transfer line which is constrained to only 6 workstations. There are three systems involved in this equipment are

- Mechanical System
- Pneumatic System
- Electronic System

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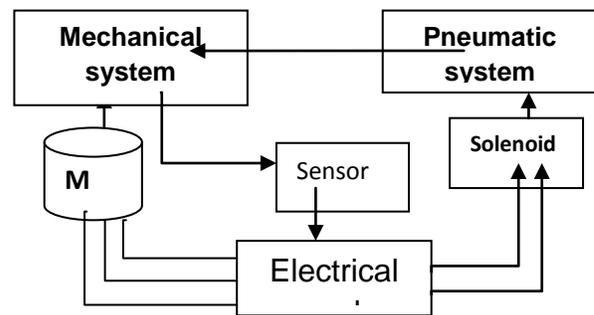


Fig no. 1.1 Cage Brightening System

Mechanical system consists of "6 station rotary transfer line" which is controlled by pneumatic system. The collecting of the bearings from the bearing hose pipe is also controlled by pneumatic cylinder which allows only one bearing at a time. Both the pneumatic and mechanical system are controlled by electronics. The bearings can be cleaned by using solutions such as kerosene, mineral spirits, diluted sulphuric acid or any commercial solvent. Cleaning solution is used to remove all lubricants and contaminants. Alkali cleaners, such as trisodium phosphate (TSP) mixed two or three ounces per gallon of hot water may also be used. Hot cleaning solutions are often used as a final cleaning or as a rinse after initial cleaning.

The present system in industries consists of manual loading and unloading which takes more time. After manual loading the bearings are kept in a closed cabin where the solvents are sprayed through nozzles and dried automatically.

Description of different systems

Mechanical system

It consists of Six Station Rotary Transfer Line with the following components:

- i. Flat Plate
- ii. Incoming Bearing Hosing Pipe
- iii. Motor
- iv. Belt Connect
- v. Air Cylinder

Pneumatic system

- i. Solenoid valves
- ii. Compressors.

Electronic system

- i. Proximity switch
- ii. Limit Switch

Mechanical system

Mechanical system consists of a six station rotary transfer line which comprises of:

Flat plate: This flat plate consists of 6 work stations which are fixed at an angle of 60 degrees, by which operations like loading, cleaning and unloading actions are performed with the help of pneumatic system. This flat plate moves up and down by pneumatic actions.

Bearing housing pipe: It is placed inclined to the machine which contains the bearings to be cleaned in a stack arrangement. The bearings are collected one after another with the help of pneumatic actions, the release of the bearings is guided by a piston which when excited releases a bearing at a time.

Motor: In this a “3-Phase induction break motor is used through which the flat plate is being motioned.

Air cylinder: Air cylinder provides the required path flow for the air and is placed above the plate to perform the upward and downward movement of the flat plate.

Pneumatic system

Pneumatic System consists of Cylinders and Solenoid valves.

Compressor: The Compressor is used to get required air pressure around 4 bars. This pressure is sent through the solenoid valves to the cylinder and allows the solenoid valves to perform the required Pneumatic actions.

Solenoid valves: The system consists of two valves which are actuated by energizing their respective solenoid coils and these two valves operate compliment to each other. One valve is open and the other is closed under normal conditions.

Design

Different systems explained above are shown in following figure



Figure no. 3. 1 Cage Brightening System

As shown in figure NO we can observe the stations are designed very effectively in space constraint. System is designed such a way the work stations are stationary where as the platform with bearing holders are rotator. Conveyor belt system is involved to rotate the Platform to desired angle through a Three Phase A.C. Motor which is controlled by the microcontroller and electronic circuit design. Limit Switches are incorporated to control the rotation and vertical moment of platform. Each bearing will be entering a station through control of pneumatics cylinder.

Electronics Design:

A microcontroller is used to control various switching logics for motor through relays and pneumatics through solenoids. Inductive type proximity sensor is used to sense any type of rotation and moment. Block diagram explains the electronic components used.

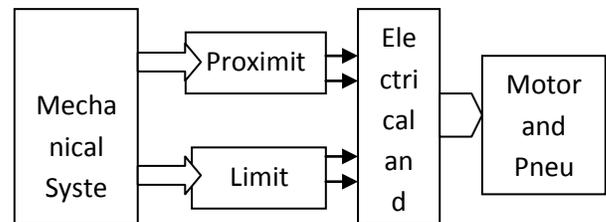


Figure no.3.2 Design Of Electrical System

Process:

There are six stations involved in cleaning the bearings among them two are operating stations, three are cleaning stations and one is drying station, all together considered as main operation. There are also supportive operations involved in cleaning the bearings like **platform** up, down movements and motor operations for rotating the plate.

Main operation

- I Loading Station
- II Acid Station
- III Water Station
- IV Fresh Water Station
- V Drying Station
- VI Unloading Station

Loading station: At this station, loading of bearings takes place in a sequential order through an inclined pipe with supportive actions. Loading can be done according to the requirement with the help of supportive actions involved in the pipe like one step one bearing or two bearings so on.

Acid station: The bearings are carried to second station by rotation of flat plate to perform the operation of cleaning in

Diluted Sulphuric Acid. The bearing is merged in the acid container.

Water station: The bearing which is cleaned at the acid station is brought to the third station where it is cleaned by using Water. The bearing is dipped three times so that the residues are removed.

Fresh water station: This is final stage of cleaning in which the bearing cleaned at Water station is brought to the Fresh water station and the bearing is dipped thrice into the water to clean it completely without any stains and rust.

Drying station: At this station, completely cleaned bearing at previous stations is brought to the drying station to dry it under hot air.

Unloading station: At this station the bearings which have undergone cleaning process are unloaded at this station.

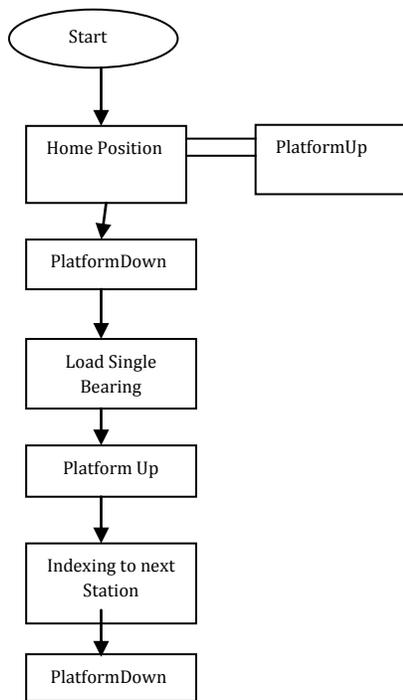


Fig 3.3 Cage Brightening Process

Conclusion:

Automation of the cage brightening system mainly saves time, decreases labour cost and quality management problems. It improves accuracy, production and quality. Effective cleaning of bearing occurs. It saves time for transferring of bearings from one workstation to other workstation for cleaning. It can have effective lifetime with frequent maintenance it may be a limitation for industries. Multiple bearing holders can be designed on same platform for making the process easier. Cleaning of bearings is very important for smoother rotation and improves the life of the bearings. So, this system helps to improve the maintenance of the bearings.

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