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Work Study to Reduce the Stressful Work by Redesigning of Material Handling Process

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Abstract

The objective of the research is to reduce the human efforts to pick and place the compressor on main assembly line of refrigerator. There are different activities in this process. Initially, to place the compressor on refrigerator, worker has to pick the compressor from given bin of compressors placed on the ground. One bin contains the four compressors. At first the bin placed on the ground from the pallet and then compressor gets picked up from bin to place it on the refrigerator. It takes approximately 25 to 30 seconds. The weight of one compressor is nearly about 8 to 10 kg and daily there are nearly 800-1000 units of production of refrigerators. Therefore, to pick the 8-10 kg compressor and then place it to the refrigerator about 800-1000 times is very heavy work for worker which results to physical problems such as shoulder pain, back pain etc.

So to reduce the human efforts and reduce the physical problem of worker, assembly has been made which can pick the compressor and place it to the refrigerator comfortably. This reduces human effort, improves the material handling and also the productivity of the process.

Keywords: Production, material handling, assembly line, productivity, ergonomics

INTRODUCTION

Materials handling is comprises of different activities such as loading, moving and unloading of materials. Materials handling equipment represents the second-largest capital cost and labor the largest operating cost. There is a trade-off between the two in that labor costs can be reduced by using more materials handling equipment (Arnold *et al,* 2008).

Materials handling makes production flow possible, as it gives dynamism to static elements such as materials, products, equipments, layout and human resources (Stock & Lambert, 2001). Groover (2001) highlights that despite its importance, materials handling is a topic that frequently is treated superficially by the companies. In order to improve the performance of distribution operations and, in this specific case, the internal material handling process, it is important to consider both human and technical factors. In the Production Function Mechanism, the concepts are directly related to a production analysis. A process analysis consists of an observation of the production flows that turn raw materials into final products. The analysis of the operations comes later because it focuses on production subjects (operators and machines). When making this distinction, it is possible to perceive the relevance of materials handling (Chakravorty, 2008).

To do material handling process safely and economically, different types of gadgets, tackles and equipment are used. Any human activity involving materials need materials handling. Materials handling as such are not a production process and hence do not add to the value of the product. It also costs money; therefore it should be eliminated or at least reduced as much as possible. However, the important point in favor of materials handling is that it helps production. The applied external forces on the body are transmitted to the support through the material of the body. Depending on the weight, volume and throughput of materials, mechanical handling of materials may become unavoidable. Operating point and operating range need to be get better system performance curve (Rattan, 2011; Modi and Seth, 2011). Whether products are to be repaired, remanufactured, or recycled, the economic interests of allthe parties involved must be understood and aligned for the activities to be performed (Chopra & Meindl, 2001).

LITERATURE REVIEW

According to Asef-Vaziri & Laporte (2005) an important proportion of manufacturing expenses can be attributed to material handling and the most critical material handling decisions in this area are the arrangement and design of material flow patterns. This idea is shared by Ioannou (2002), which argues that an important aspect of any production system is the design of a material handling system (MHS) which integrates the production operations.

It is well understood that material handling improvement may have positive effects over production. However, it is not only production, but the way the employees see the new situation. The secret of the fluid power's success and widespread use is its versatility and manageability (Esposit, 2008). When the perception is favourable, the benefits are possible; if not, behavioral issues can emerge. Evaluations are important when interventions into the work environment are implemented. By means of effective materials handling management, the company's operational performance may improve (Chopra & Meindl, 2001). The unit load principle stands as one of the most important and widely applied principles in material handling. In material handling, a unit load simply the mass that is to be moved or otherwise handled at one

time. The unit load may consist of only one part, it may consist of a container loaded with multiple parts, or it may consist of a pallet loaded with multiple containers of parts.(Groover, 2001). Product reliability and product quality are closely related to each other (Bhandari, 2010).

According to Sujono & Lashkari (2006), material handling accounts for 30–75% of the total cost of a product along the production chain, and efficient material handling can be responsible for reducing the manufacturing system operations cost by 15–30%. According to Chan *et al.* (1999), a key factor in material handling system design process is the selection and configuration of equipment for material transportation.

RESEARCH METHOD

Objective of research is to find out better method to lift the compressor of refrigerator.

As a regular practise of lifting the compressor, a single compressor from bin lifted using manual mechanism. This creates stress in the spinal cord area of labour. New mechanism considers the mechanisms like chain mechanism, conveyor, electromagnetic lifting, ergonomic lifter, pneumatic lifter/vacuum technology etc. The main purpose is to identify current prevailing technologies to lift compressor and adding it to the process so that to develop ergonomically better way to lift the compressor.

Designing and implementing new compressor lifting system

During lifting of single compressor from bin, the orientation of each compressor inside bin is different. So it's difficult to lift the one compressor and also it increases the cycle time. Hence, it has been recommended to lift all the four compressors at a time from bin. For that, need to consider electromagnetic mechanism and pneumatic/vacuum technology for holding of compressors. Compressor is hermetically sealed, that means it is with motor. So during use of electromagnetic mechanism, there may be magnetic defect on motor of compressor. Hence, prefer use of pneumatic mechanism i.e. vacuum technology is confirmed for holding. And for lifting the whole assembly, the options are spring balancer, pneumatic air balancer or electrical motor. Spring balancer and pneumatic air lifter are rejected due to high jerk and high cost respectively. Hence, electric motor has an advantage and preferred.

Fig.1: Orientation of compressors in bin

As per the orientation of compressors inside bin, it is difficult to get grip of single compressor for lifting it from the bin hence it has been decided to lift the all four compressors at a time. Therefore for holding assembly of compressors rectangular frame been made which can support better grip. For holding vacuum pads, ventures are preferred. In case failure of vacuum pads or venture to avoid falling of compressors, lock should be provided. Holing assembly should be lifted by lifter motor which slides on rail way. This rail way can rotate freely on vertical 'I-section' column. The rail way is supported by the cantilever truss. This truss will be fixed on the 'I-section' column.

For easy rotation of the truss with track about column, it will fix on the vertical rods and these rods are fixed in the inner race of the bearings. Outer race of bearings will be fixed on the plates welded on the top of 'I-section' of column.

Fig.2: Arrangement of bins

Vacuum is used as gripping force. The lifting is a function of the degree of vacuum achieved and the size of the area on the part where the vacuum is applied. Vacuum grippers work on Bernoulli's principle where suction is created by using compressed air. The relative high vacuum is created by vacuum generator which is powered by an electric motor. Vacuum cups are used for lifting objects. They are made of synthetic rubber.

PNEUMATICS CONTROL: PICKING AND LIFTING THE LOAD

The vacuum generator generates a vacuum in vacuum reservoir and then in vacuum distributer the difference between negative pressure and ambient pressure draws the work piece to the suction plate when device is place on the work piece. This is generally called 'picking up' the work piece.

LOWERING AND RELEASING THE LOAD

Device has controller, which control the chain hoist after picking up the load using lifting device.To release the load, the vacuum in the distributor is eliminated through atmospheric venting. The vacuum reservoir remains filled for next lifting process.

ADVANTAGES OF VACUUM TECHNOLOGY:

- It requires only one surface to grasp an object.
- Applies a uniform pressure on surface of an object.
- It relatively needs a lightweight gripper.
- Suitable to a variety of different materials.
- It has very low cost.
- It can be used on curved or contoured surface as well as flat surface.
- Flexibility of vacuum cup provides the assembly with a certain amount of compliance.

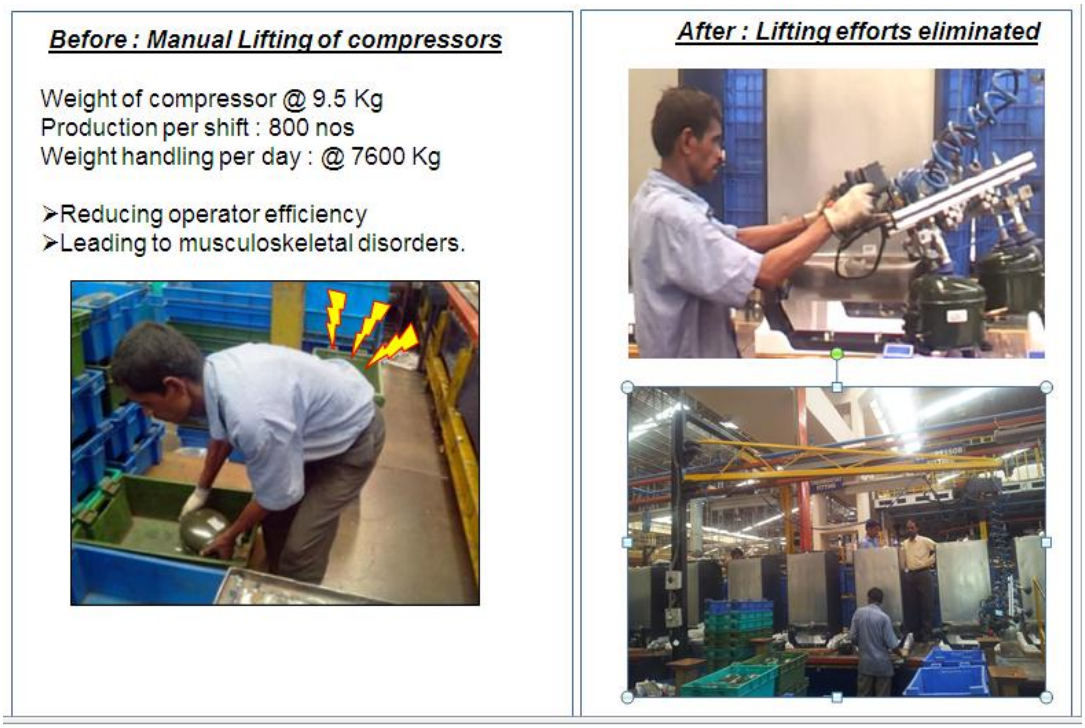

Fig.1: Difference in before and after work

When worker has to pick the compressors, he moves the lifting assembly towards bin containing 4 compressors using roller and track mechanism. After that he put the vacuum pads on the compressors and starts the vacuum selector switch and pressured air flows through the venture and suction is created. Vacuum pads grip the four compressors. Then worker press the up switch of the remote on handle, due to which motor lifts the load. After this worker moves the lifted load towards assembly line and press the down button on remote. This lowers the load. After lowering the load vacuum selector switch made to off by worker and compressors get released on the assembly line.

For any emergency in system one ***'Emergency Stop*** 'button is also provided on the Remote on handle. If there is any crack on the air pipe or small lick in pipe then it will

compensate it easily because System is designed for the 4.5 bar pressure and line pressure is about 5.5 to 6 bar, hence small pressure drop is permissible. There is no possibility of the fall down of compressor because if there is any cut on the vacuum pad, then respective pad or cup will not grip the compressor.

CONCLUSION

Human efforts are reduced using the new system of material handling. Now operator can lift four compressors instead of one, hence, it also increases operational efficiency. Due to semi-automatic mechanism possibility of falling compressors is avoided. The cycle time of operation also gets reduced. Initially there were requirement of two operators to completely assemble the compressor in refrigerator, but now one operator is sufficient for completing work.

FUTURE SCOPE

Pick and place mechanism is a semi-automatic robot may appear human being or simple electromechanically device. A robot mechanism will acts under direct control of human. This project involves design and development of model for reducing human efforts, to pick and place the compressor on main assembly, to pick and place the compressor on main assembly line.

Scope of human mechanism as follows:

Vacuum mechanism like robot may be used to perform task that are too dangerous or difficult to implement directly.

- Nuclear west clean up: It may be used to automate relative task that can be performed.
- Medical application: Mechanism includes Nano robotics using swarm robotics systems which consist of surgeries and operation can be done using knowledge of robot mechanism.
- In future mechanism like vacuum, oiled, electric robot application will know about extend to field outside of manufacturing.
- The possibilities include hazardous work environment, defense application, space exploration, and undersea preparation,

These are also opportunities for robot to be used in service industries, in restaurant, hospitals etc. similar activities.

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