Study on Design & Analysis Roller conveyor for multi-degree of freedom and weight Optimization

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Abstract: - In general, a conveyor is highly significant in the material handling industry, but the cost of running a conveyor system is considerable, and adequate maintenance is necessary. This raises the system's overall cost, particularly in the case of the heavy conveyor system. Our project is an attempt to create a system that minimizes the total cost of a roller conveyor system, which is used in many sectors to feed goods on a regular basis. As a result, it became critical to implement a system that can operate at a very cheap cost and consumes very little power. We have built a modified system to minimize power usage in this study. With this purpose in mind, solid work is used to conduct a design study of the changed system. In the current design of a roller conveyor system, rollers are grouped in a single row and are used to handle both light and heavy weight items, thus the power consumption must be adjusted for both circumstances (heavy and light), which takes a long time and a lot of energy. The roller conveyors in our project are positioned in two rows rather than one. Seven rollers are positioned in the upper row and seven rollers are arranged in the lower row to save electricity and increase efficiency. Upper and lower rollers are automatically engaged and disengaged based on load application to save power usage. And the same amount of electricity will be used as in the event of a lightweight materials load.

Key Words: — ***Detachable conveyor, Roller conveyor, multi degrees of freedom, optimization in conveyor.***

I. INTRODUCTION

Conveyor belt and roller conveyor belt is used in many industries to transport product goods and material between stages of a process. Roller conveyors are a most powerful material handling tool. They provide the opportunity to the faster (boost) productivity and decreasing the damages and minimum labor cost in a manufacturing and distribution facility. Roller conveyor is mostly useful in the application involving transportation of heavy or bulky materials. Currently system in where metal or glass is melted and shaped into object factory is heavy and having the problem of wear in belt weight and improper roller support.

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Also, the all-research paper focuses on material, strain, load capacity and design. But nobody focuses on multi-degree of freedom for roller conveyor belt and also roller conveyor is detachable. Right now, factory needs that type of roller conveyor who is lots of strain, load capacity, detachable and there is not particular axis fix in roller conveyor.

Over the years a lot of work has done and is still continuing with great effort to save weight and cost of applications. The current trend is to provide weight/cost effective products which meet the stringent requirements. The aim of this paper is to study existing conveyor system and optimize the critical parts like roller, shafts, C-channels for chassis and support, to minimize the overall weight of assembly and material saving so the review the paper and find the PROBLEM DEFINITION and give suggestion that the objective of this paper. Over the years, a lot of work has been done, and it is constantly being done, to reduce the weight and cost of applications. The current tendency is to offer light-weight, low-cost goods that meet the most severe specifications. The goal of this paper is to examine existing conveyor systems and optimize critical parts such as rollers, shafts, and C-channels for chassis and support in order to reduce overall assembly weight and save material. To do so, review the paper and

Determine the PROBLEM DEFINITION and make recommendations, which is the goal of this paper.

II. LITERATURE REVIEW

2.1 Roller conveying system. This relates to a new roller conveying system.

The author of this study described a roller conveying system that consists of two axially spaced supporting frames that are essentially parallel in the conveying direction of the roller. A conveyor system, at least one roller, and at least one supporting structure Each supporting shaft is designed to be engaged in a tone of the supporting tubular frames to support the at least one of the supporting tubular frames to support the at least one of the supporting tubular frames at least one driving roller and one first supporting roller each supporting shaft's bearing

2.2 Low-mass roller or pulley

This paper discusses rollers and pulleys for use in industrial equipment, with a focus on low-mass rollers and pulleys for use in flat-belt machines, sorting and conveying postal goods, and conveyor systems. A low-mass roller is disclosed, which includes a cylindrical body made of polymeric material with an exterior surface, first and second open ends, and an interior tubular space defined along a longitudinal axis for receiving an axle; and an outer shell made of thin metal covering the cylindrical body's exterior surface. The assembly of the first and second tubular shells comprises a weld ring positioned between and nested inside the first and second tubular shells' respective first and second ends to keep the shells aligned throughout the welding operation.

2.3 Latest Developments in Belt Conveyor Technology

Show cases the most recent advancements in belt conveyor technology, as well as how traditional components may be used in non-traditional applications that need horizontal curves and intermediate drives, which has revolutionized and increased belt conveyor possibilities. Examples of complicated conveying applications will be discussed, as well as the numerical tools necessary to ensure dependability and availability. Henderson PC2, with a length of 16.2611 km, is one of the world's longest single-flight conventional conveyors. However, a 19.123-kilometer conveyor is now being built in the United States, while a 23.52-kilometer trip is being planned in Australia. Various conveyors with a length of 30-50 kilometers are being considered in other regions of the world.

2.4 Survey of Research in Modeling Conveyor - based Automated Material Handling System in Wafer Fabs.

Discusses the literature on conveyor system models in semiconductors. There are detailed overviews of simulation-oriented models. In addition, we identify and debate particular research requirements and difficulties in the field Closed-loop conveyor control are included in the design. It has been determined that Conveyor systems require new analytical and simulation models.to be created in order to comprehend the behavior of such systems close the gap between theoretical research and real-world issues in order to reduce product development time and costs,3 dimensions in the CAD/CAE system are used to increase product quality. Essential it is required to create a system that makes use of the data for the entire process of idea design at an early-stage development of a product. The goal of this research is to increase product quality by doing sufficient design study iteration early in the design process. According to C. Sekimoto, a CAD system that can be utilized for the idea of design and an appropriate CAD environment should be developed, with additional goal of reducing product development time at the late stage of design.

2.5 Long distance magnetic conveyor for positioning of ultra-cold atom.

The use of several conveyor systems to facilitate machine loading and unloading is discussed. The research presented in this paper not only considers the concept of balancing the number of parallel machines, the conveyor speed for adjacent pallets, the overall relevant costs, and the number of conveyors into the goal, but also proposes a two-staged method for optimizing the combined problem to achieve maximum profit. In addition, this paper discusses automated sensitivity analysis. This work adds an applicable scheme for manufacturing production design and gives a significant instrument for operations research engineers in today's manufacturing with profound understanding to definitively achieve the best profit of a given production quantity. This study concludes that it provides an adaptive and efficient tool for production design in order to maximize profit from a given order quantity

2.6 Modeling and Analysis of Industrial Belt Conveyor System Using Cero Parametric and Ansys Software

The examination and analysis of roller is carried out in this work. It is critical in industries to shift work pieces from one workstation to the next in order to reduce worker participation. This article is about the design of a conveyor that may be utilized in industries. The major goal of this

research is to look at roller analysis. This necessitated doing a thorough static analysis. The research focuses on static analysis. Using the Cad programmer Pro/E Wildfire 4.0, a suitable Finite Element Model is created.

2.7 It is a principal object of the present invention to provide a roller assembly for a power free triple conveyor

Another writer who elaborated: Triple conveyor with no motor required. The roller assembly for a power free triple conveyor with an overload release device includes a sprocket mounted on a Shaft through a bearing, a roller separately formed and freely rotated on the sprocket, a plurality of springs resiliently installed within the holes of the roller, a pair of friction plates and snap ring located adjacent to the roller, and a guide rail fixed at the upper portion of the frame. In an unmanned robot environment, the conveyor may decrease noise and vibration between drive members while transporting items rapidly and precisely.

2.8 Design and Analysis of a Roller Conveyor for Weight Optimization & Material Saving

The goal of this study was to develop a general energy model for long belt conveyors based on belt resistance. In order to provide a more realistic picture of the carried bulk material across the belt, they employed a two-parameter power equation as well as a partial differential equation through the belt to calculate the variability of the material mass per unit length on the belt. The power consumption calculations of the newly proposed simplified model are compatible with those of the known non-linear model, with an error of less than 4%

2.9 An investigation into design and mechanical conveyors systems for food processing

Shows how the idea of concurrent engineering, as well as the concepts of design for manufacturing and design for assembly, were used to explore the functionality, material appropriateness, cost, and simplicity of assembly of various essential conveyor elements in the overall conveyor system. The important sections were reworked with new shapes and geometry, as well as new materials in some cases. On a new test conveyor system created, manufactured, and built utilizing the new enhanced components, the better design processes and functioning of new conveyor parts were validated and tested. The enhanced approach for conveyor component design and manufacturing is based on the minimizing of material, part, and cost by employing design criteria for produced and assembled components. The benefits of employing improved tact's are confirmed by results produced on a test conveyor system. When compared to traditional methods, the overall material cost was lowered by 19% and the overall assembly cost was reduced by 20%.

2.10 Availability modeling of powered roller conveyor

The dependability and availability of two popular line-shaft roller conveyor configurations are examined in this research. The first is a typical design, in which each roller is belted directly to the conveyor's spinning line shaft. The second is a novel design in which just one top roller is belted to the line shaft, and all other rollers in a series arrangement are belted to the one powered roller.

The fundamental rationale for this design is because upper belts are easier to repair than line shaft belts, resulting in higher system availability. The latter arrangement, on the other hand, is less dependable since a single belt failure might result in several roller failures.

2.11 The present invention relates generally to conveyor systems and more particularly to a roller conveyor system

Frame with a pair of spaced apart rails and at least one roller assembly with an extended shaft is disclosed in a further roller conveyor system explained by framing as a roller conveyor system. A first bearing assembly is fastened to one rail, while a second bearing assembly is secured to the opposite rail, and each bearing assembly comprises an inner and outer race. The extended roller shaft is radially aligned with the inner race of one of the bearing Assemblies because it extends across the inner races of the bearing assemblies. The bearing inner race is then thread ably attached with threaded fastener with one end fitted to abut against the shaft flat. The other end of the fastener is essentially flush with an exterior surface of the bearing race when it is in abutment with the shaft flat. The fastener is then positioned in abutment with the shaft flat by placing an annular collar over the outer surface of the bearing inner race, which has an inner diameter substantially equal to the outer diameter of the bearing inner race. The shaft is then fastened with at least one roller at an intermediate location.

2.12 A roller having a torque overload release mechanism for use with an accumulating roller conveyor system

For use with an accumulating roller conveyor system, a roller with a torque overload release mechanism. A rotational shaft is fixed to a conveyor system's frame, and a rotatable driving sprocket is mounted to one end of the shaft. A first friction pad is attached to the shaft and abuts one end of the drive sprocket, while a second friction pad is attached to the shaft

and abuts the other axial end.

When the torque between the shaft and the sprocket exceeds a predefined but adjustable level, a nut variable compresses one or more washers against the second friction pad, drivingly connecting the drive sprocket and shaft together and allowing torque overload release. A roller conveyor system consists of a set of rotational rollers fixed to a frame that, when combined, form a conveyor track on which goods are carried. One or more rollers are rotational driven, allowing the driven rollers to engage and move the objects from one end of the conveyor track to the other.

2.13 Design Optimization, Analysis and Remedies Over Failure of Charging Belt Conveyor System Used in The Industry to Set the Optimum Results.

The goal of this article is to help you choose the correct belt conveyor and system components. It was a funded project by Yash Enterprises in Buldhana's Khamgaon. The difficulties of various components in the system were investigated, and the appropriate remedy was provided to extend component life. The ultimate goal was to develop a redesigned design that would allow for larger-scale idler manufacture while increasing efficiency and output. This article provided solutions to a variety of issues.

2.14 Analysis and Optimization of Gravity Roller Conveyor Using Ansys.

The goal of this article was to lower the resistance of a belt conveyor in order to reduce its energy consumption. Belt rolling conveyor, conveyor sliding resistance, bending resistance, idlers rotating resistance, and bulk material flexure resistance are some of the many resistances. The most energy savings are predicted in the selection of belts and idlers, as well as in some circumstances, innovative route options. The test rig was used to evaluate various idler and belt resistances. Reduced resistance resulted in a 34% reduction in energy use. The belt conveyor, which is utilized in mining, was investigated.

2.15 Modeling and energy efficiency optimization of belt conveyors

The major goal of this article was to analyses the gravity Roller Conveyor, conduct a detailed analysis of current gravity rollers, and optimize their portions utilizing composite materials in order to reduce the system's weight. Using Pro-E software, a finite element model of the existing system was created. Only the roller is optimized in this paper by employing composite material.

2.16 Modeling and Analysis of Industrial Belt Conveyor System Using Cero Parametric and Ansys Software

The research of structural analysis was done in this work. The modeling is done using Cero Software, and the FEA is done with ANSYS software to acquire variation of stress at crucial locations of the system, as well as applying boundary conditions to assess total deformation, equivalent stress, and shear stress. For system and belt rollers, ASTM A-36 hot rolled steel bar and nylon 66 materials were investigated.

III. PROBLEM STATEMENT

In general, the conveyor system is used to move materials from one area to another, but owing to the frequent changes in loading circumstances, this is not always the case. A certain amount of power has been lost. Some design improvements to the present design of the roller conveyor system are used to reduce power usage.

The current belt conveyor design is heavyweight, with critical parts such as rollers, belts, roller shafts, supporting brackets, and C channel base frames, all of which have a direct impact on excessive material use and cost increases. As a result of the heavy weight system, power consumption and maintenance are higher. To address these issues, a redesign of the present system as well as analysis and optimization will be carried out. Most important all conveyors are not detachable and mostly conveyor is fix direction that's why conveyor is not use in multiply Purpose so this are the problem are find out. From all above papers, it is found that very less work is Carried out on the belt conveyors of Foundry. Itis also found That, they have used the conveyor system and worked on Energy conservation of conveyor and weight reduction of Single component in system. In my project work I mainly Concentrate on the weight reduction technique on all critical Components of conveyor system using Modelling and Analysis software. Based on all of the previous studies, it appears that the Foundry's belt conveyors see virtually little use. It was also discovered that they used a conveyor system and worked on reducing the weight of each individual component in the system while conserving energy. In my project work, I primarily focus on give some ideas to reduce the weight of all important conveyor system components and crate review.

3.1 Suggestion provides

- Roller conveyor is needed to be self-rotating power supply.
- Roller conveyor is individually rotation motion; they

do not need belt support.

- The SN curve may be used to do fatigue analysis. The number of cycles in various places is predicted using ANSYS.
- To determine the maximum load, buckling analysis of support channels can be performed.
- Material non-linearity can be taken into account in order to obtain more precise findings.

- It is feasible to reduce the weight of the conveyor by adopting lower-quality materials.
- Thermal analysis might be used to help in the research.
- The Roller Conveyor's mechanical components must be developed separately and tested in the assembly environment. External forces operating on the entire assembly must be tested on the structure.
- The Roller Conveyor's mechanical components must be developed separately and tested.

3.2 Equations

Bending stress

$\sigma b = 32M/(\pi d^{3}) (1 - k^{4}))$

Where, M: Bending moment at the point of interest

d: Outer diameter of the shaft

K: Ratio of inner to outer diameters of the shaft

(k = 0 for a solid shaft because inner diameter is zero)

Axial Stress:

$\sigma a = 4aF/ (\pi d_{0})^{2} (1 - k^{2}))$

Where,

F: Axial force (tensile or compressive)

α: Column-action factor (= 1.0 for tensile load)

The term α has been introduced in the equation.

This is referred to as the column action factor. What is the definition of a column action factor? This is caused by the buckling of long, thin members that are subjected to axial compressive stresses.

Combined Bending and Axial stress:

Both bending and axial stresses are normal stresses;

Hence the net normal stress is given by,

$\sigma x = [32m/\pi do^{3}(1 - k^{4}) \pm 4aF/\pi do^{2}(1 - k^{4})$

Design of the shaft mostly uses maximum shear stress theory.

It states that a machine member fails when the maximum shear stress at a point exceeds the maximum allowable shear stress for the shaft material.

Therefore,

$\tau max = \tau allowable = \sqrt{[(\sigma x/2)^{2}] + \tau xy^{2}}$ Therefore,

The shaft diameter can be calculated in terms of external loads and material properties.

IV. CONCLUSION

The following are critical parameters that lower the weight of Channels:

- Roller outer diameter
- Roller thickness.
- Design individual self-support

Airports, subway stations, department shops, and other commercial and public structures all use roller conveyors. In high-rise structures, lift machines are particularly frequent. Conveyor belts are similar to roller conveyors. In mass production; roller conveyors play a critical function. On a conveyor system, for example, parts created or raw materials travel down the assembly line. Workers are positioned in one location, while the item to be worked on moves past them. The level of safety exceeds the standard, and there is room for weight reduction and, as a result, lower power consumption thanks to the improved design. The number of components is not decreased significantly, but owing to design changes, they are reorganized in such a way that they can handle the greatest load while reducing the assembly's weight.

Single self-rotating roller conveyor design so the not necessary to conveyor is particular axis fix you can use multiply degree of freedom.

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