Roller Conveyor Assembly for Material Handling: A Review

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Abstract - Basically a conveyor is very important in the material handling industries but for running a conveyor system consumption of electricity is very high and proper maintenance is required. This increases the overall cost of the system especially in the heavy conveyor system. Our project is an attempt to design a system which reduces the overall cost of roller conveyor system as the system is required in many industries for the regular supply of materials. So it became very important to introduce a system which can work at very low cost with the low consumption of electricity. In this paper we have been designed a modified system to reduced power consumption. With this goal keeping in our mind design analysis of the modified system is carried out with the help of CATIA V521.

In the existing design of roller conveyor system rollers are arranged in one row which is used for handling both the light and heavy weight materials, so the power consumption is being adjusted for both the conditions (heavy and low) which takes lots of time and power .In our project the roller conveyors are arranged in two rows instead of one. In the upper row seven rollers and in the lower row seven rollers are arranged to save the power and enhance the efficiency. According to load application upper and lower rollers are engaged and disengaged automatically to save the power consumption. And same amount of power will be consumed as in the case of lightweight materials load application.

Keywords: Roller Conveyor System, Geometric modeling, Material handling, Power Saving roller.

I. INTRODUCTION

A roller conveyor system is a material handling equipment that carries materials from one location to another either heavy or light weight material. Conveyors are especially useful in the applications involving the transportation of heavy or bulky materials. Conveyor system allows quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveyor systems are available, and are used according to the various requirements of different industries.

A roller conveyor in a known manner includes a plurality of driven rollers disposed in two parallel tracks. With each driven roller a drive motor is associated. From a first voltage source a first se of the driven rollers is supplied, wherein a second voltage source is provided, from which a further set of the driven rollers is supplied. This arrangement offers a high degree of redundancy in the event of the failure of individual components of the roller drive, thereby guaranteeing an emergency operation in such a situation.

II. PROBLEM STATEMENT

Generally it has been observed that the conveyor system is used for the material transferring from one location to another location but due to the frequent change in the loading conditions. More or less power has been lost. To save the power consumption optimization is done by some design modifications in the existing design of roller conveyor system.

III. NEED OF A CONVEYOR SYSTEM

With the beginning of the 20th century bring the industrial revolution as well as much great advancement in conveyor technology. In 1901, the first steel belt was invented in Sweden. They can be installed almost anywhere, and are much safer than using a forklift or other machine to move materials. They can move loads of all shapes, sizes and weights. Also, have many advanced safety features that help prevent accidents. There are a variety of options available for running conveying systems, including the hydraulic, mechanical and fully automated systems, which are equipped to fit individual needs.

Fig. 3.1 Roller Conveyor [1]

The following are the:

IV.OBJECTIVES OF THE STUDY

1. Study existing roller conveyor system and its design.
2. Geometric modeling of existing roller conveyor.
3. To generate parametric model using ANSYS
4. Optimization analysis of modified roller conveyor.
5. To carry out Analysis of Modified design for same loading condition.
6. Recommendation of new solution for weight optimization.

V. LITERATURE REVIEW

In this paper review of available literature related with the roller conveyor system, material handling equipment, design and analysis, modified none modified has been carried out.

In this paper author explained a roller conveying that includes two axially spaced supporting frames substantially parallel in the conveying direction of the conveying system, at least one roller, and one supporting shaft, each supporting shaft configured to be engaged in at least one of the supporting tubular frames to support the at least one driving roller, and at least one first supporting bearing for each supporting shaft [1].

This paper explains about the rollers and pulleys for use with industrial equipment and, more particularly, to rollers and pulleys having low-mass for use in machines using flat belts, machines for sorting and transporting mail articles, conveyor systems.

A low-mass roller is disclosed comprising a cylindrical body formed of polymeric material and having an exterior surface, first and second open ends and defining an interior tubular space along a longitudinal axis there through for receiving an axle; and an outer shell formed of thin metal covering the exterior surface of the cylindrical body. The assembly of the first and second tubular shells includes a weld ring disposed between and nested within the first respective ends of the first and second tubular shells such that the shells are held together in alignment during the welding process [2].

In fact in this first aspect the invention relates to a conveying system comprising: two axially spaced supporting frames extending substantially parallel in the conveying direction (F) of the conveying system; at least one plurality of rollers; at least one plurality of supporting shafts, each adapted to be engaged in at least one of said supporting tubular frames to support at least one roller; characterized in that each roller comprises: at least one roller body extending around a rotation axis X-X; at least one engaging seat for at least one supporting shaft, placed concentrically to said roller body, at least first removable coupling means for a second roller, a cover or a spacer.; at least a radial seat realized on the outer surface of said supporting shaft. In the present invention scope the terms "axial", "axially", denote a direction substantially perpendicular to the feed direction (F) of goods in the conveying system [3].

Further author Reynolds Ronald explain about low-mass roller is disclosed comprising a cylindrical body formed of polymeric material and having an exterior surface, first and second open ends and defining an interior tubular space along a longitudinal axis there through for receiving an axle; and an outer shell formed of thin metal covering the exterior surface of the cylindrical body. In another aspect, the outer shell of the low-mass roller comprises an assembly of first and second tubular shells having inside diameters, equal within a predetermined tolerance, at first respective ends thereof, wherein the first respective ends are joined together and welded. The assembly of the first and second tubular shells includes a weld ring disposed between and nested within the first respective ends of the first and second tubular shells such that the shells are held together in alignment during the welding process [4].

In roller producing method author Kazuki IKEDA explained manufacturing method is provided for a roller, by which a roller having low eccentricity and high surface smoothness can be obtained without the need to perform cumbersome processes such as polishing of a foamed layer, etc. The manufacturing method for a roller includes the steps of injecting a foam-layer compound into the space between a core bar, which is disposed at the centre of a cylindrical mould, and an electron-beam-irradiated tube, which has an outer diameter somewhat smaller than an inside diameter of the cylindrical mould, and which is set inside the cylindrical mould; and heating and foaming the foam-layer compound, so that the outer surface of the electron-beam-irradiated tube is pressed against the inner surface of the cylindrical mould [5].

In this roller track are used for storage rack, Roller Conveyor, or similar apparatus and in this author Charles E. High smith, Springfield explained roller track for a storage rack arranged for gravitational flow of load-bearing pellets. Freely rotatable rollers are journal led, each on a spindle, between two parallel walls. Rollers of a first group are journal led on spindles bolted to the walls. Rollers of a second group are journal led on spindles held by but not bolted to the walls. Each of the latter spindles has, at each end, a shoulder portion larger than an aperture in one of the walls and a pintle portion fitted into the aperture. The pintle portion has a cylindrical wall and the aperture has a cylindrical margin. Along at least a substantial portion of the roller track, every third roller is a roller of the first group while every other roller is a roller of the second group. This invention pertains to improvements in a roller track for a storage rack, roller conveyor, or similar apparatus. The roller track has a

novel arrangement of freely rotatable rollers journalled between two parallel walls. [6].

Further roller conveyor system explained by framing as a roller conveyor system is disclosed having a frame with a pair of spaced apart rails and at least one roller assembly having an elongated shaft. A first bearing assembly is secured to one rail while a second bearing assembly is secured to the other rail so that the bearing assemblies are aligned with each other and each bearing assembly includes an inner and outer race. The elongated roller shaft extends through the inner races of the bearing assemblies so that a flat formed on the shaft is radially aligned with the inner race of one of the bearing assemblies. A threaded fastener is then thread ably secured to the bearing inner race and has one end adapted to abut against the shaft flat. With the fastener in abutment with the shaft flat, the other end of the fastener is substantially flush with an outer surface of the bearing race. An annular collar is then positioned over the outer surface of the bearing inner race and this collar has an inner diameter substantially the same as the outer diameter of the bearing inner race to thus hold the fastener in abutment with the shaft flat. At least one roller is then secured to an intermediate point of the shaft [7].

For heavy unit load conveyor wheel it explained simplified construction for a conveyor Wheel Wherein the outer shell of the Wheel is formed from two identical shell members Which can be identical stampings, With these stampings being hardened and then fixed together to define the assembled shell. The stampings when fixed together are disposed in opposed relationship, and the stampings have inner arcuate raceways which directly define an outer race Way for an annular array of bearing balls. The stampings have outer transversely oriented channel parts which, when the raceways are fixed together, have the open channel parts aligned and abutted to define a generally closed tubular cross section which defines the rim of the Wheel. The channel parts have outer flanges which effectively abut and define the outer annular tread of the Wheel, the latter being substantially cylindrical to provide a smooth and flat cylindrical surface having a substantial contact area for a load. The edges of the tread are rounded to prevent load damage or hang-up [8].

For transporting low mass author Richard E. Reeves explained a low mass transport shaft is formed by crimping a thin wall tube to form two opposed grooves along the length of the shaft. The two grooves impart rigidity to the tube structure enabling it to be used for such purposes as paper transport shaft. In the embodiment shown, a pair of feed rollers is rigidly attached along predetermined points on the shaft; the rollers rotate with the shaft, and serve to move objects in contact therewith such as paper along a predetermined path [9].

Conveyor for stacking cases in run- through storage structure comprises a bearing cage into which snap the ends of an axle carrying a roller, the bearing cage having a projection engaging into an opening in a frame member of the storage structure and being retained therein by a complementary projection engaging into the same opening from the opposite side of the frame member. The rollers allow forward movement, under the force of gravity, of each stacking box or carton in the structure from the rear forward, in other words, from a loading point to a removal point. Since the rollers are often exposed to a considerable weight loading, they have to be built in a correspondingly stable manner and be fastened in large numbers to the Frame members [10].

Power roller conveyor: A cantilevered roller assembly for a conveyor system includes a non-rotating shaft, a sprocket, a roller, a sleeve, and a clutching spring. The non-rotating shaft has a first end with a first retention feature and second end with a second retention feature. The sprocket is rotatable disposed over the shaft. The roller is rotatable disposed over the shaft adjacent the sprocket. The sleeve is slid ably and rotatable disposed over the non-rotating shaft. The sleeve has a first end in non-rotatable engagement with one of the sprocket and the roller on a first end and has a second end with an adjusting nut threadably disposed there over. The clutching spring is axially disposed between the second end of the sleeve and the second end of the shaft. The clutching spring induces clutching load between the sprocket and the roller. Rotation of the nut varies the clutching load between the sprocket and the roller [11].

Another author who explained Power free triple conveyor. This invention relates to a roller assembly for a power free triple conveyor having an overload release device which 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. The conveyor can reduce noise and vibration between the drive members in an un-manned robot environment, and transport products quickly and accurately [12].

An accumulating conveyor comprising a frame on which a plurality of horizontally spaced apart power rollers are positioned for propelling articles along the conveyor. Each power roller includes a tubular metal roller member terminating at opposite ends and having an axial passageway extending between and through its opposite

ends. A motor driven Shaft which mounted on the frame extends through the roller passageway and supports a friction drive member formed of powdered metal and impregnated with. The friction drive member is positioned in the passageway in frictional engagement with the roller member and rotates conjointly with the drive shaft. Rotation of the drive shaft is transmitted by the friction drive member to propel the articles along the conveyor. When the movement of the article is restrained, the friction drive member slips in the passageway relative 'to the roller member so that the roller member remains motionless [13].

In this author explain about the separate drive assembly of rolling conveyor: A rolling conveyor has a frame on Which a plurality of feed rollers that define a conveyor surface are rotatable supported, at least some of the feed rollers each have a first drive Wheel, Which is in rotary drive communication With a second drive Wheel, the second drive Wheels are located on a rotatable drive shaft With Which they are each in rotary drive communication via a respective slip clutch, at least one and preferably all the second drive Wheels and the associated slip clutch are combined each into a separate drive assembly that can be installed as a unit, the drive assembly is supported rotatable on the frame, and the drive shaft is received in the drive assembly in a manner fixed against relative rotation and preferably longitudinally displaceable [14].

A roller having a torque overload release mechanism for use with an accumulating roller conveyor system. A shaft is rotatable mounted to a frame for the conveyor system while a drive sprocket is rotatable mounted to one end of the shaft. A first friction pad is secured to the shaft and abuts against one end of the drive sprocket while a second friction pad to the shaft and abuts against the other axial end of drive sprocket. A nut variable compresses one or mo. washers against the second friction pad to thereby drivingly connect to the drive sprocket and shaft together and permit torque overload release when the torque between the shaft and the sprocket exceeds predetermined but adjustable amount. In a roller conveyor system, a plurality of rollers is rotatable mounted to a frame and, together, defines a conveyor track upon which articles are conveyed. One or more of the rollers are rotatable driven so that the driven rollers engage and propel the articles from one end and to the other end of the conveyor track [15].

Power and free roller conveyor: A plurality of rollers are carried by a support and have friction wheels fixedly secured, the wheels being frictionally engaged by further friction wheels which are slidably and non-rotatable carried on an input drive shaft. Biasing springs on the shaft urge the wheels into engagement with the wheels and the bias of the springs is adjustable by collars on the shaft to selectively vary the torque transmitted from the shaft to the rollers. It is known to provide power and free roller conveys in which at least some of the rollers have frictional driving engagement with driven shafts which extend axially through the rollers. The arrangement is such that the weight of an article on a roller results in sufficient frictional force to drive the roller, but if the article is arrested the frictional driving engagement is over come and the roller ceases to rotate, thereby avoiding wear on the transported articles. For satisfactory operation of such conveyors the friction force between each roller and its drive shaft is critical, being dependent on the weight of the articles being transported [16].

In this bushing system for live roller conveyor author explained how this bushing conveyor works. The invention provides an improved live roller conveyor system for preventing damage to conveyed cases of goods when stopped upon live rollers. In an embodiment of the invention, a live roller comprises a drive shaft with a plurality of roller members rotatable affixed thereto. One or more bushings are provided between an inner surface of each roller member and an outer surface of said drive shaft. When a conveyed case is stopped along the conveyor, for example, during case layer formation for loading onto a pallet, the rollers underneath the case stop rotating relative to the drive shaft due to slippage between the bushings and drive shaft. The present invention relates generally to rollers for conveying loads along a conveyor and, more particularly, to a bushing system for powered rollers within a live roller conveyor [17].

Author Marco Willi, Benningen am Neckar (DE); Volker Porzer, BaltmannsWeiler (DE);Hans Peter Buttau Lauffen (DE); Peter Ludwig' Tuebingen (DE); UWe Lindemann, Holzgerlingen (DE) ,proposed about the rolling conveyor of drive assembly, A rolling Conveyor has a plurality Of feed rollers that define a conveyor surface, in Which the feed rollers are joined on their end region rotatable to a first end and second bearing assembly each have a first drive Wheel, Which is in rotary drive communication each With one second drive Wheel, the second drive Wheels are located on a rotatable drive shaft, With Which they are in rotary drive communication, Wherein the drive shaft is joined rotatable to a third bearing assembly, Which is embodied separately from the first and second bearing assemblies, so that a drive shaft assembly comprising the drive shaft and the associated third bearing assemblies is joined as a unit detachably to the rolling conveyor [18].

Conveyor driving roller the disclosed invention relates to an adaption of a conventional conveyor driving roller whereby the driving force frictionally transmitted from a rotating shaft to the article conveying roller is maintained

even under conditions wherein oil or water enters between the frictionally engaging surfaces. Specially, a pressure plate is provided at one end face of the roller which is spring biased for frictionally engaging that roller end face. Provision is made for adjustment of the degree of compression of the pressure plate biasing spring so that the degree of frictional force between the pressure plate and the roller end face may be varied [19].

Fig. 5.1 Roller Conveyor assembly

Detailed assembly of gravity roller conveyor system is shown in figure 3 [20]

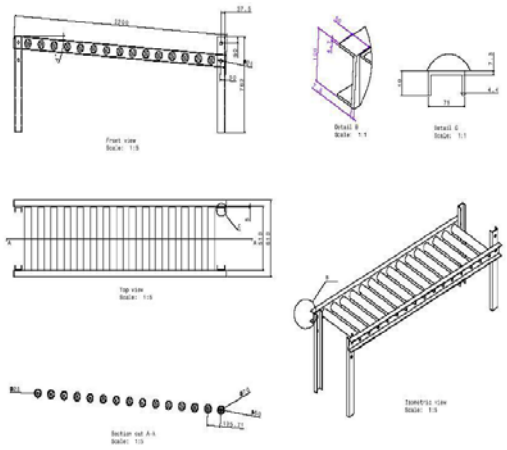

Fig. 5.2 Detailed drawing of a roller conveyor system [20]

VI. CONCLUSION

Roller conveyors operate in airports, underground stations, department stores, and other commercial and public buildings. The lift machines are very common in the high rise buildings. Roller conveyors are like conveyor belt. Roller conveyors play an important role in mass production. for example parts produced or raw materials move along the assembly line on a conveyor system. Workers stand in one place, and the material to be worked on move past them.

Safety is very greater than the requirement and there is a scope for weight reduction and consequently power consumption reduces through the modified design. In which number of components are not reduced in a very large amount but due to the modifications in the design these are rearranged in such a manner that they can carry maximum load and with the reduction of weight of the assembly.

• Critical parameter which reduces the weight of Channels are as follows:

- Roller outer diameter
- Roller thickness.

VII. FUTURE SCOPE

1) Fatigue analysis for life span calculation: Fatigue analysis can be done by obtaining the SN curve. ANSYS predicts the number of cycles of different regions.

2) Buckling analysis: Buckling analysis of support channels can be done to find maximum load.

3) Non-linear analysis: Material non-linearity can be considered to find more accurate results.

4) Selection of appropriate material: By selecting inferior quality of material further weight reduction of conveyor is possible.

5) Thermal Analysis: Thermal analysis may be carried out for the further study.

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