"Design And Development of Load Operated Transfer Trolly"

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Abstract - Material handling is main operation in industry. Material handling involves transfer of jobs from one machine station to another storage and packaging. Weight operated material handling device has large load carrying capacity, less or no maintenance. This project is basically weighting operated material handling device. This device has more reliability. This material handling equipment paper is not only based on for material handling, it is not required external power i.e., electrical, it totally operate and depends on weight of material or job. Industrial material handling device are operating on electrical power but this device does not required electricity, it is operating on weight of job. This project develops the problem of different types of material handling equipment in a typical material handling system. Spring operated material handling equipment has large load carrying capacity, easy maintenance and high reliability of operation. Material handling equipment is the media of transportation of material from one point to another in a commercial point or space.

Index Terms - Design, Fabrication, Research, Material handling.

I. INTRODUCTION

Material handling is process of movement of job or material from one place to another place i.e., from one machine to another store room to machine shop or from machine shop to store. In many industries material handling is automated but it requires more electricity and it is main contribution of price of the product. Some small-scale industries material handling is manually material handling is risk full or harm full to workers or manpower. This may lead to back pain or muscular pain. This material handling device eliminates the manual material for short distance between two machine stations. These material handling devices also reduce the pries of the product by minimizing material handling cost. These also reduce the cost of power. In this device potential energy of the job is used to transfer of the job. Nowadays, major, medium as well as small local automotive manufacturing industries are experiencing rapid development in concept of technology and system applied, resulted by stronger domestic and global market demands. As the companies grow, the need for efficient material handling system also arises especially in the manufacturing area. Material handling system is one of the basic components that complement the whole manufacturing operation. Material handling system basically refers to any equipment, activities and procedures related to the moving, storing, controlling and protecting of materials flow in a manufacturing system. It provides the manufacturing system with smooth material flow without excess inline and outline inventory. The material handling system is categorized as non-value added (NVA) activities which implying that the less material handling involved is the better. However, it is impossible to totally eliminate the material handling activities in any manufacturing operation. Hence an efficient and effective material handling system is always the ultimate objective by many companies. Material handling operations involve raw material movements, subassemblies; work in process (WIP), tools, finished products, and other support materials from one point to another in the plant. Basically, material handling equipment is used to the picking an object from one place and travel to it and place at another location without much power of man wasting.

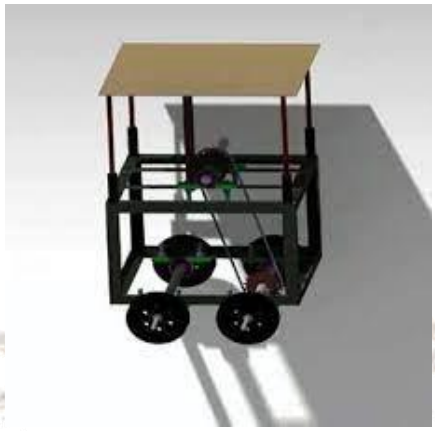

Figure. 1.1

II. AIM :

To develop a smart transfer trolley that helps in easy to use and quick shifting of material from one place to another. To show the new innovation in the field of mechanical engineering

III. OBJECTIVES :

Self-weight acting material handling machines are working on the weight of the material to be carried; they do not require any kind of fuel or electric current for travelling from one place to another place. Material handling machines are used in heavy engineering works like steel plant, forging, casting industry. Sometimes this may result process into delay in further production. Also, in these processes there is no chance of accidents since the vehicle is travelling in a straight direction on the track on which the wheels are mounted. The above-mentioned systems may prove time consuming. Hence the need of a system of conveyance that can give intermittent as well as continues mode of operation will have a fast response as well as can be suitably modified to the need of variety of components in the system layout. Also, the material handling device which is carrying the load must have low maintenance and must led a long period for service.

1) To make use of mechanical material handling devices to reduce manual work.
2) To ensure safe, effective and flexible material handling.
3) To arrange material and material handling devices in a manner, not to disturb the production activities.
4) To make use of gravity forces for material movement, wherever possible.
5) To use the principle of containerization, unit load or palletization and move optimum number of pieces at a time.

IV. PROBLEM IDENTIFICATION :

- The normal material handling systems & conveyor assembly normally involves the use of channels, rollers and shaft that are heavy by virtue of their structure and the material used as steel also they will have operated on power sources.
- There is continuous power consumption. To overcome this problem, we can use weight & spring-operated material handling system.

V. CONCEPTUAL DESIGN :

Since, core part of our project is Rack & pinion hence at first development stage we decided to Design rack & pinion then Helical spring & bearing selection. A Rack and pinion gear system is composed of two gears. The normal helical gear is the pinion gear and the straight helical gear is the rack. The rack has teeth cut into it and they mesh the teeth of the pinion gear. Rack and pinion gear provides a greater feedback and steering sensation. A Good deal of time and effort is often expended in moving material one place to another this handling is costly and adds nothing to the value of product. During manual handling of material, there are many chances to occur accident, which waste the time as well as money of the manufacturing firm or industry. Therefore, in order to move material by most appropriate method and equipment at the lowest possible cost and regard safety the material-handling device are introduced.

Design of material handling Systems: A common approach to the design of MH systems (MHSs) is to consider MH as a cost to be minimized. This approach may be the most appropriate in many situations because, while MH can add real value to a product, it is usually difficult to identify and quantify the benefits associated with MH; it is much easier to identify and quantify the costs of MH (e.g., the cost of MH equipment, the cost of indirect MH labor, etc.). Once the design of a production process (exclusive of MH considerations) is completed, alternate MHS designs are generated, each of which satisfies the MH requirements of the production process. The least cost MHS design is then selected. The appropriateness of the use of MHS cost as the sole criterion to select a MHS design depends on the degree to which the other aspects of the production process are able to be changed. If a completely new facility and production process is being designed, then the total cost of production is the most appropriate criterion to use in selecting a MHS—the lowest cost MHS may not result in the lowest total cost of production. If it is too costly to even consider changing the basic layout of a facility and the production process, then MHS cost is the only criterion that need be considered. In practice, it is difficult to consider all of the components of total production cost simultaneously, even if a new facility and production process is being designed. Aspects of the design that have the largest impact on total cost are at some point fixed and become constraints with respect to the remaining aspects of the design.

Figure. Conceptual design

VI. LITERATURE REVIEW :

Material handling (MH) involves short-distance movement that usually takes place within the confines of a building such as a plant or a warehouse and between a building and a transportation agency.

It can be used to create time and place utility‖ through the handling, storage, and control of material, as distinct from manufacturing (i.e., fabrication and assembly operations), which creates form utility‖ by changing the shape, form, and makeup of material. It is often said that MH only adds to the cost of a product, it does not add to the value of a product. Although MH does not provide a product with form utility, the time and place utility provided by MH can add real value to a product, i.e., the value of a product can increase after MH has taken place; for example:

The value (to the customer) added by the overnight delivery of a package (e.g., Federal Express) is greater than or equal to the additional cost of the service as compared to regular mail service otherwise regular mail would have been used. The value added by having parts stored next to a bottleneck machine is the savings associated with the increase in machine utilization minus the cost of storing the parts at the machine.

VII. METHODOLOGY :

To start of this project, a meeting with guide in the first week is done to manage the schedule of weekly meetings. The purpose is to inform the guide on the progress of the project and guided by the guide to solve difficulty. Briefing based on the introduction and next task of the project is given by guide. Make research of literature review with the means of the internet, books, available published articles and materials that is related to the title.

Step 1: - Identification of problem: In day-to-day life electrical energy have evolved as one of the most basic needs of human being. We know that for the material handling we need to more human effort and need of more electrical energy. Today we required material handling equipment should be cheap and challenge to safe. To reduce material handling cost so we choose material handling equipment for our project work.

Step 2: - Literature Survey: Various studies have been made in different industries to indicate that the cost of handling alone accounts for about 20-25% for the total manufacturing cost.

Step 3: - Design of Mechanical Part: This phase involves the design of various elements such as spring, shaft & gear.

Step 4: - Software Modelling: Detailed drawing using AUTO-cad software, Creo software ANSYS software. Designed part is drawing using AUTO-cad.

Step 5: - Fabrication: All the designed elements are manufactured in the workshop such as frame, shaft as per design and also select the part as per specification for e.g., rack and pinion, support rod chain and sprocket etc. Upper frame, lower frame, cross bar is manufacturing in workshop

Step 6: - Assembly: All the manufactured and selected parts are assembled together. The assembly of the equipment is in two steps

- Assembly of main frame with Rack & Pinion.
- Assembly between main frame and cross bar tension mechanics

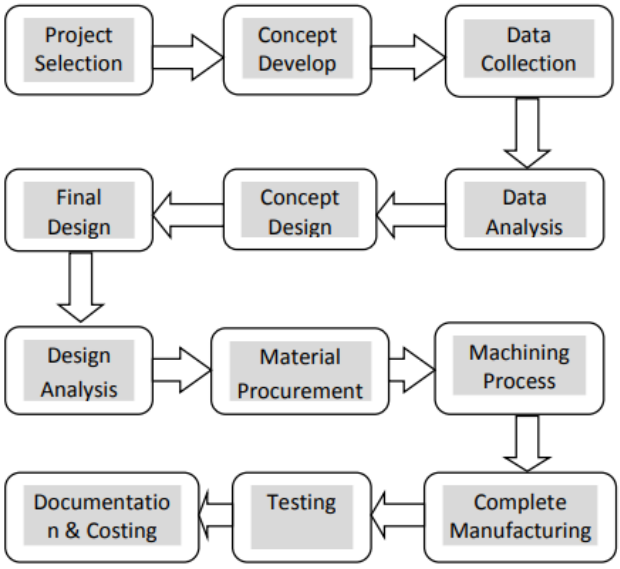

Figure. Process chart

VIII. COMPONENTS UTILISED PROJECT :

1. Base plate
2. Main frame
3. Rack & pinion mechanism
4. Supporting rod.
5. Chain & sprocket drive
6. Helical tension spring.
7. Shaft.
8. Wheels.
9. Bearing

Wheels

A wheel is a circular block of a hard and durable material at whose centre has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines. For the prototype on the waste collecting machine there are 4 wheels which support and transfer the load to the ground. For the future production, using of rocker bogie needs 6 wheels, these 6 wheels need separate motors and speed controllers which is expensive.

Specifications:

- Wheel diameter: 305mm
- Wheel width: 40mm

Figure 2.1 Wheels

Sprocket

A sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and differs from a pulley in that sprockets have teeth and pulleys are smooth. No. of teeth on sprocket (freewheel) = 18 No. of teeth on driving sprocket = 44

Figure 3.1 Sprocket

Chain drive

A chain drive consists of an endless chain wrapped around two sprockets.it is a series of links connected by pin joints.it has some features of belt drives and some of gear drives. Chain drive can be used for long as well as short centre distances and they have good flexibility in all directions. Chain drives compared with belt drives

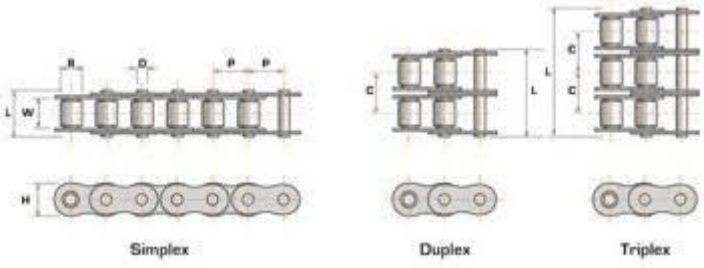

Figure 8.3 Simplex chain

Simplex chain

Pitch = 0.5 inch

Length = 6 meter

Chain sprocket

Pitch = 0.5 inch

No of teeth = 24

- Chain drives can be used for long as well as short centre distances. They are particularly suitable for medium centre distance, where gear drives will require additional idler gears. Thus, chain drives can be used over a wide range of centre distances.
- ii. a number of shafts can be driven in the same or opposite direction by means of the chain from a single driving sprocket.
- iii. chain drives have small overall dimensions than belt drives, resulting in compact unit.
- iv. a chain does not slip and to that extent, chain drive is a positive drive.
- v. the efficiency of chain drives is high. For properly lubricated chain, the efficiency of chain drive is from 96% to 98%.
- vi. chain does not require initial tension. Therefore, the forces acting on shafts are reduced.
- vii. atmospheric conditions and temperatures do not affect the performance of chain drives. They do not present any fire hazard.
- Hence chain drives were selected for this project The velocity ratio i of the chain drives is given by, $i=n1n2=z2z1$ where n1, n2 = speeds of rotation of driven and driving shafts (rpm) z1, z2= number of teeth on driven and driving sprockets.
- The average velocity of the chain is given by, $\mathbf{v=\pi DN60*103v=\ zpn60*103}$ Where V is the average velocity of in m/s,
- The length of the chain is always expressed in terms of the number of links; L=Ln*p,
- Where; L=length of the chain, Ln=length of the links in the chain.

Bearings

- Bearing is a mechanical element that permits relative motion between two parts, such as the shaft and the housing, with minimum friction. The functions of the bearing are as follows:
  - The bearing ensures free rotation of the shaft or the axle with minimum friction.
  - The bearing supports the shaft or the axle and holds it in the correct position.
  - The bearing takes up the forces that act on the shaft or the axle and transmits them to the frame or the foundation.
- In this project roller bearings, of pillow block bearings and cone hub type block bearing were used. Wheels: In its primitive form, a wheel is a circular block of a hard and durable material at whose centre has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis. Metal welded wheels as they easily move forward in Agri field due to their own weight were used in the project.

Figure. 5 Bearing

Rack and pinion mechanism

A rack and pinion are a type of linear actuator that comprises a circular gear (the *pinion* engaging a linear gear (the *rack*). Together, they convert rotational motion into linear motion. Rotating the pinion causes the rack to be driven in a line. Conversely, moving the rack linearly will cause the pinion to rotate. A rack and pinion drive can use both straight and helical gears. Though some suggest helical gears are quieter in operation, no hard evidence

supports this theory. Helical racks, while being more affordable, have proven to increase side torque on the datums, increasing operating temperature leading to premature wear. Straight racks require a lower driving force and offer increased torque and speed per percentage of gear ratio which allows lower operating temperature and lessens visual friction and energy use. The maximum force that can be transmitted in a rack and pinion mechanism is determined by the tooth pitch and the size of the pinion as well as the gear ratio.

Figure. 6 Rack and pinion

IX. PLANNING OF FURTHER WORK:

- Synchronization of the various component involved in the system.
- Study of fabrication of load operated transfer and work on it.
- List of equipment along with costing is to be prepared.
- Various brands for different equipment are to be search and the most economical one is to be selected.
- Procuring the parts and assembling the system would be the next job to be done.
- Testing is to be part or if the system is working or not.
- According to the test result modifications are to be made if required.

X. COST ANALYSIS :

Sr. No.	Components	Price (Rs)
1	RUNNER WHEEL DIA = 6 INCH	1000
2	SIMPLEX CHAIN 12 MM PITCH	600
3	DIAMETER OF DRIVE SPROCKET 68 MM	1200
4	DIAMETER PF DRIVEN SPROCKET 40MM	600
5	PEDESTAL BEARING = UCP 25	2000
6	MILD STEEL SHAFT = 25MM	800
7	MAIN FRAME	4000
8	RACK AND PINION	1000
9	SLIDING CHANNEL	2000
10	FABRICATION CHARGES	2000
TOTAL		**14,200/-**

XI. RESULTS AND CONCLUSION:

1. Results

- Easy to handle
- Easily operated on irregular surfaces.
- It is operated on slope surfaces also.
- It adjusts automatically, so time is consumed.
- And no manpower is requiring behind it.
- It is used in construction side for workers

2. Conclusion

- We conclude that we completed project named Material handling equipment It works on the self-weight of job object which has to be transfer from one place to another place without using electricity or fuel. By using this system, we save energy as well as save cost Material handling equipment is the media of transportation of material from one point to another in a commercial point or space. Industrial material handling device are operated on electrical power but this device does not required electricity, it is operated on weight of job. Hence, we are satisfied with our work.
- The trolley has been successfully designed and fabricated. Functioning of the same has been confirmed by loading conditions and found working as per requirements. Automation of wheel has been developed successfully and tested to reduce the human effort at the handle of the trolley for giving appropriate direction. The same working model of trolley is being developed with more creative modifications in future as per the required market conditions.
- It works on the self-weight of job or object which has to be transfer from one machine station to other machine station without consumption of any type of fuel or electricity. Hence this equipment is best suitable alternative for existing material handling equipment. By the use of this type of equipment we reduce the energy consumption which also helpful for overall cost reduction. The most important thing we conserving our energy sources which are much useful in future growth and development.

XII. FUTURE SCOPE:

The machine is constructed for main objective of minimizing the energy consumption & increasing the flexibility in the premises of small-scale industries. There are many areas for improvement & modification. Some of the improvements that can be implemented are as follows: This machine is fully mechanically operated so the functioning of machine can be advanced by using.

a) combination of mechanical & electronic component. Motions can be made accurate by using limit switches.

b) If gear locking mechanism is used desired distance can be achieved though the distance is less than design one.

c) By using gear reduction technique maximum distance can be covered by same load.

d) Rail tracks can be made in use to give desired direction to machine.

e) By varying the stiffness of the spring loads can also be varied.

XIII. FINAL MODEL:

Figure. Final model

XIV. REFERENCES:

- [1] “Carlos E. Villanueva et.al.” “Flexible Manufacture Module” and “Automated Guided Vehicle” Flexible Manufacturing System http://www.researchgate.net/publication automated guided vehicle
- [2] "R. A. Gujar et al.""Design of the shaft at fatigue loading & various formulas “#Bedford, United Kingdom: IFS Publications Ltd.
- [3] V. B. Bhandari, Design of Machine Element, McGraw Hill Education (INDIA) PVT. LTD, New Delhi, 2013.
- [4] R. S. Khurmi & J. K. Gupta, Theory of Machine, S. Chand publication, New Delhi, 2008.
- [5] Murphy, R. R., & Arking, R. C. (1988), Autonomous mobile robots in flexible manufacturing systems.
- [6] ‘‘Ghazi Abu Taher et.al.” “Automation of Material Handling with Bucket Elevator and Belt Conveyor” International Journal of Scientific and Research Publications, Volume 4, Issue 3, March 2014 ISSN 2250-3153.
- [7] “Satbeer Singh Bhatia et.al” “Static analysis of helical compression spring” IJRET: International Journal of Research in Engineering and Technology eISSN: 2319- 1163 | pISSN: 2321-7308.
- [8] ‘‘Abhilasha Dongre et.al.” “Significance of Selection of Material Handling System Design in Industry – A Review” International Journal of Engineering Research and General Science Volume 3, Issue 2, March-April, 2015 ISSN 2091-273.
- [9] Oskarsson, M., K. & Astrom Accurate and automatic surveying of beacon positions for an AGV (1998).
- [10] Laser guided vehicle, Dept. of Mathematics, Lund Institute of Technology, Sweeden, 1998.
- [11] “Design and fabrication of rack and pinion lift”, A. Thirugnanam, Praphul das and Lenin Rakesh, Middle-East Journal of Scientific research 20 (6): 744-748,2014