Design And Manufacturing of Rotary Material Storage System

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Abstract- *Now days in industry, materials (which are available in raw material, finished parts, assembly parts etc.) are kept in a storeroom with stock and mix-up parts to each other which may be damage. So, secure tools, raw material, manufactured parts, and assembly parts of industry have stored in rotary storage system.*

This system is very useful for material storage in industrial application. Storage compartments rotate by using chain and sprocket mechanism. It is simple to operate with the employee to store the material in the system at the ground level. Each employee has a unique ID for store material in compartments and retrieved material from compartments. Since the model makes use of composite parts, it is easy to assemble and dismantle and is thus more convenient than the traditional storage systems.

Keywords- Material Handling, Material Storage, Inventory, Stacker, RFID Technology.

I. INTRODUCTION

It is simple to operate with the employee storing material in the system at the ground level. Once the employee leaves the incorporated safety zone the compartment is automatically stored material by the system rotating to lift the stored material compartment away from the bottom central position. This leaves an empty compartment available at the ground level for the next material to be stored in. The stored materials are easily retrieved by pushing the button for the relevant position number of the compartment is material stored in. This causes the required compartment to rotate down to ground level ready for the employee to enter the safety zone and receive material out of the system. Except all other systems use a large ground area, Rotary storage System is developed to utilize maximum vertical area in the available minimum ground area. It is quite successful when installed in minimum areas which are well established and are suffering with shortage of area for storing material in industry. Although the construction of this system seems to be easy, it will be par from understanding without the knowledge of materials, chains, sprockets, bearings, and machining operations, kinematic and dynamic mechanism.

The Rotary Storage System for material such as material stored in storeroom, tools and equipment stored in cupboard etc. have been implemented on a huge scale. But these systems have a major disadvantage of large space consumption and worst management of organization which is successfully eliminated with the use of a rotary storage system. Moreover, the latter provides the added benefits of flexible operation without the need of an attendant and added security and least chances of materials damage. Since the model makes use of composite parts, it is easy to assemble and dismantle and is thus more convenient than the traditional material storing systems. The rotary model is specifically designed to accommodate material separately with less space .The materials are safely store and retrieve uniformly and unique shaped items. The structure can accommodate six compartments in the space and can even be customized to hold a greater number depending upon the requirements of the organization. Storage spaces cannot cope with the growth of the different type of the materials. The structure of the system is like a building. The basic structure of the rotary storage system can be described with the help of block diagram.

II. VARIOUS PARTS OF ROTARY MATERIAL STORAGE SYSTEM

i. CHAIN AND SPROCKET MECHANISM:

A sprocket is a toothed wheel that fits onto a shaft. It is prevented from rotating on the shaft by a key that fits into keyways in the sprocket and shaft. A chain is used to connect two sprockets. One sprocket is the driver sprocket. The other sprocket is the driven sprocket. Motion and force can be transmitted via the chain from one sprocket to another, therefore from one shaft to another. Chains that are used to transmit motion and force from one sprocket to another are called power transmission chains. An advantage of chain drives over most belt drives is that the chain cannot slip on the sprocket, so the chain and sprocket provides a positive, non-

slip drive, i.e. the chain cannot slip on the sprocket because the sprocket teeth prevent the chain from slipping.

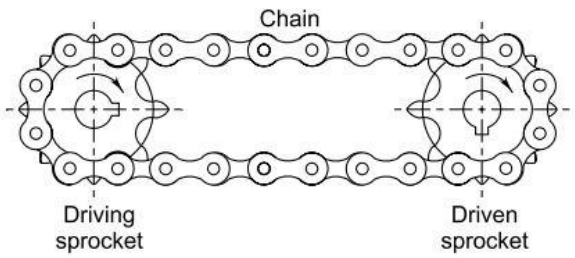

Fig 1. Sprocket design

ii. BRACKETS

Brackets are the supporting members for carriers. They have one end fixed on chain side and another end fitted with carriers. They act like a cantilever beam.

iii. CARRIERS

Carriers are the load carrying members which move along the guided path i.e. Ellipse. Carriers are designed such that, it has the highest possible load carrying capacity with minimum self-weight.

iv. ELECTRIC GEARED MOTOR

This type of motor contains induction motor along with gear box as a unique body. Use of this motor type makes structure compact.

Fig 2. Electric geared motor

v. LINEAR CONTROL SYSTEM :

The linear control system controls the relay which directly has control on the motor. The compartment movement of storing is dependent on the movement of the motor shaft. This movement can be clockwise as well as anticlockwise in both the directions according to the users' requirement. Not only the relay operation but also the Radio Frequency Identification (RFID) controls the users' details and sensors i.e. InfraRed Sensors are used for getting the details of the compartments, i.e., whether it is occupied or not. All these systems are controlled by the microcontroller.

a. InfraRed (IR) Sensor:

The infrared sensor allows detecting an object's distance.

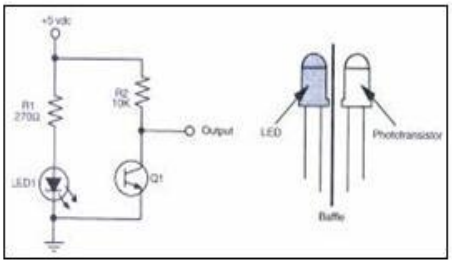

Fig 3: Infrared Sensor

Every compartment is fitted with a Light Emitting Diode (LED) and an IR sensor at the opposite ends on the inner side. This combination is used to check the status of the compartment, i.e., whether or not it is occupied.

b. RFID Tag/Reader:

RFID is an abbreviation for Radio Frequency Identification. An RFID system consists of two parts .i.e., a reader, and one or more transponders, which are also known as tags. RFID systems have evolved from barcode labels as a means to automatically identify and track products as well as people. In the rotary storage system, the user is assigned a unique ID corresponding to the specific compartment. This helps in quick identification and movement of the same.

c.. Microcontroller

The IC AT89S51is a low-power, high-performance CMOS 8- bit microcontroller and has 4K bytes of in-system programmable flash memory. This chip is manufactured using Atmel's high-density non-volatile memory technology and it is compatible with the industry- standard 80C51 instruction set and pin out. The on-chip flash memory allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. Microcontroller 89S51 is preferred over 89C51 in this project due to the fact that the former requires 5V for its operation whereas the latter needs to be supplied with 12V.

III. CALCULATION

(Readings are taken from Data Table)

Given Data

Torque acting on the motor is T= 10 kg= 98.06 N.m
RPM =N= 100rpm

Design of chain-sprocket:

Let, Number of teeth = Z1= 20 (sprocket)
Tooth correction factor, K2 = 1.18
Multiple strand factor, K1=1
Service factor, Ks=1.0s
POWER (P) P=1026.63 W
Power rating of Chain = 870.23W= 0.870 KW
The Power rating at 08 B is 100rpm & .64 KW power
For chain number 08B

***Dimensions:**

Pitch (P) P=12.70 mm
Roller diameter (d1)d1=8.51 mm (max.)
Width (b1) b1=7.75mm
Transverse Pitch (Pt) Pt=13.92mm

Breaking load

Simple = 17800 N
Duplex = 31100 N
Triplex = 44500 N

***Pitch Circle diameter of driving & driven shaft (PCD)**

Both sprockets are same

For driving sprocket D1= 85mm
For driven sprocket D2= 85mm

***Number of chain link (Ln)**

No of links are Ln=83
Central distance a= 400 mm

To calculate tension in chain

The chain velocity is V= 0.423 m/s
The chain tension is T1= 2055.4 N= 2.056KN
Factor of safety FS=8.66

Shaft design

Specification:

Material of shaft is Mild steel
Material properties of mild steel

Yield strength	Syt	247MPa , N/mm2
Ultimate tensile strength	Sut	841 Mpa, N/mm2
Factor of safety	FS	2
Poisons ratio	μ	.303
θ		180°

Permissible shear stress

$$\tau = 151.38\ N/mm2$$

Torsion moment:

T1= 2055.4 N
T2= 793.28 N
T3=2055.11 N
T4=793.28 N

Bending moment:

Mt1=53627.77N.mm
Mt2= 53627.77N.mm

Force on sprocket 1 at pt. B
F1 =2848.39 N
Similarly force on the other sprocket at pt. C
F2= 2848.39 N

The reactions at support

R_D=2848.39 N
R_A=2848.39 N

Bending moment at pt. B
(Mb)B=105390.43 N.mm
Bending moment at pt C
(Mb)C =105390.43 N. mm
Bending moment at pt. A & D
(Mb)A,D=0 N.mm

Shaft diameter,

Taking safe value diameter of shaft is **16 mm**

IV. CAD MODELLING OF AN ROTARY STORAGFE SYSTEM:

PARTS FRAME:

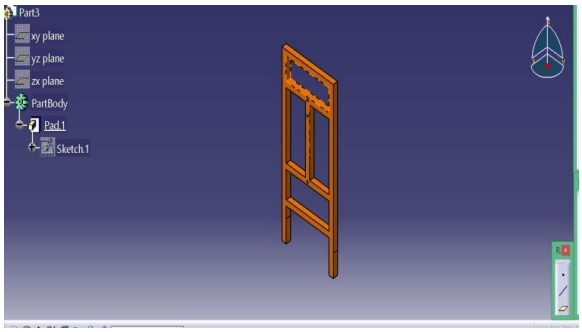

Fig 4: Frame of rotary storage system

As per the design the central distance between the sprockets is about 400 mm & we need to left the 140 mm distance up & down for the free rotation of storage shell. So we consider the hieght of the frame 670 mm & width of stand 430 & length 300mm.

To create catia model we used some cammnds. First we draw a profile of frame & then pad it upto 25 mm.

Coze c/s of frame is 25*25. Then join the both frame by connecting a bar between them.

MOTOR PLATE :

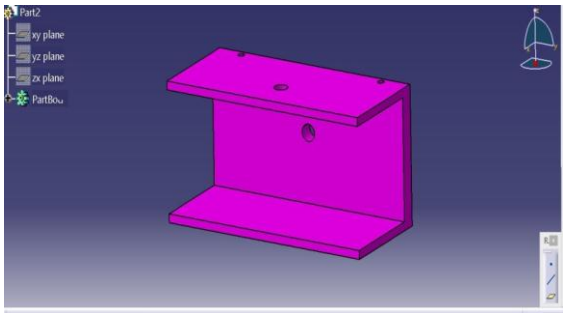

Fig 5: Motor Plate of Storage System

The motor plate is used to fix the motor to drive the shaft. To create this part we used the pad & pocket command.

First we draw the Profile like C & Pad it.

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SHAFT :

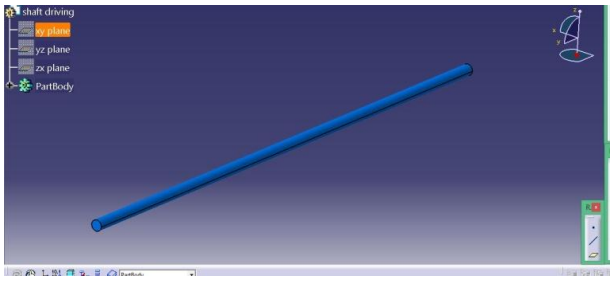

Fig 6: Shaft of Rotary Storage System

1.4 STORAGE SHELL

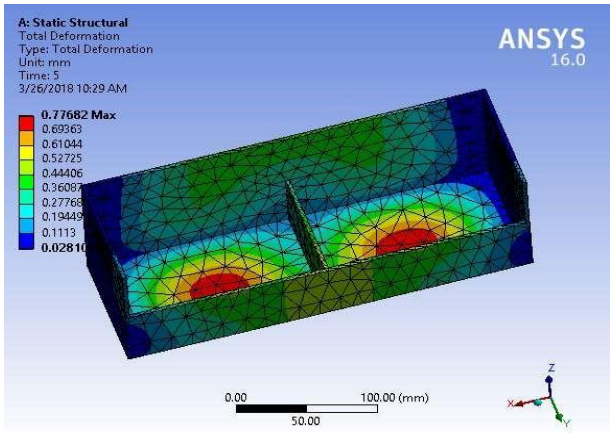

Fig 7: Storage Shell

V. CONCLUDING REMARKS AND SCOPE FOR THE FUTURE WORK

SCOPE

The smart inventory storage system has minimum work volume. The benefit of this concept is it does not require any additional costly material handling equipment such as stacker. As far as small-scale industries are concerned everyone will prefer to invest nearly 3 lakhs for this concept rather than paying nearly 6 lakhs for designing stacker & rack separately. The concept can be preferred because of its less cost, satisfactory capacity & ease of handling. If operational space stacker is neglected, SISS takes only 17% more space than simple racks of same capacity which is worth to invest in it.

OBJECTIVE

- To achieve Safety and security - No material damage.
- To achieve save time for material handling in industry.
- To achieve Environment-friendly industries.
- To achieve systematic storing material in separate compartments.
- To achieve better management for organization.

- Improved inventory record accuracy in organization.

ADVANTAGES

- Better organize tools, parts and equipment in a rotary storage.
- Increase organizational efficiency and productivity.
- Space-efficient and cost-effective storage system.
- Provide extra measure of security for stored material.
- Keep tools, parts and equipmentfrom being lost or damaged.
- System design allows storage flexibility.

APPLICATION:

- In Industry
- In mechanical Workshops

CONCLUSION

Material handling and storage is one of the important concerns of any industry. Everyone tries to minimize its inventory as inventory carrying and storage cost are much higher. All industries try to make inventory storage and material handling with as less space as possible. The attempt is also given to make all these operations easy in terms of effort, time, and safety. So our design fulfill all those requirements.

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