International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Design of Mechanism for Retrieval of Tray in STO Lift Machine

Pandav Abhinav S.[1], M. B. Mandale[2]

[1]*PG Student, Department of Mechanical Engineering,*

Rajarambapu Institute of Technology,Rajaramnagar MS 415414, India

[2]*Assistant Professor, Department of Mechanical Engineering,*

Rajarambapu Institute of Technology,Rajaramnagar MS 415414, India

ABSTRACT

This paper presents the design of mechanism for retrieval of tray in STO (Product Name) Lift machine to minimize the height between two trays. The retrieval is used for automatic motion of storage and retrieves of the tray. The chain lever type mechanism is used for retrieval mechanism, which reduces the pitch of the trays. The design is performed to increase the efficiency and work ability. Because of this the number of trays increased and also storage of material can be increased. The design involves, motor selection, frame design, tray design, chain drive selection, shaft design, lever design. These parts are fabricated and assembled by welding, profile cutting, cutting and bending process.

Keywords: Automatic Storage And Retrieval System, Retrieval Mechanism, Pitch Of The Trays.

I. INTRODUCTION

Automatic storage and retrieval systems are designed for automated storage and retrieval of parts and items in manufacturing, distribution, retail, wholesale and institutions. They first originated in the 1960s, initially focusing on heavy pallet loads but with the evolution of the technology handled loads have become smaller. STO lift consists in a storage column in which small items are stored in extractable trays. These trays are inserted and extracted by a powered device, which travels vertically between the front and the rear shelving of this column, in order to make available in front of the picker the specific tray he needs to process his picking order.

Figure 1 STO lift machine used in industry[12]

The moving device is guided by an automated control system, which is usually interfaced with a software system, so that to set the correct order of trays retrieval.

Due to large product variety accompanied with customer requirements for fast deliveries and more frequent deliveries, Material handling system producers are constantly developing new solution of automated storage system. To meet the requirements of the customers automated STO lift system is produces .

Figure 1 shows the STO lift machine used in industry. In this machine retrieval system is shown the transformation of material denoted by arrows. The design of tray for STO lift storage machine is more important task in industry which manufactures such type of system. There are many companies whose manufactures STO lift machine. They design different types of tray for improving the load carrying capacity and also design according to their mechanism.

Automated storage and retrieval systems is complex systems and development of an automated storage and retrieval system can last for several years. Therefore, these system help the customer for validate the design the system work as expected.

Jainil prajapati et. Al. gives the information about the design and working process of automatic storage and retrieval system for different parts. This is required for the reducing the space used for storing and handling different materials like small parts.

Tone Lerher studies the statistically significant factors affecting the performance of the Shuttle Based Storage and Retrieval System (SBS/RS).

Girish Dalvi and Sanjay Rukhande were design and development of the electronically operated vertical storage system. After fabrication the system is tested successfully.

Priti Kumari et. al. were built up an automatic storage and retrieval robot to store and retrieval task. Also they maintain the time accuracy and speed for performing the task.

II METHODOLOGY

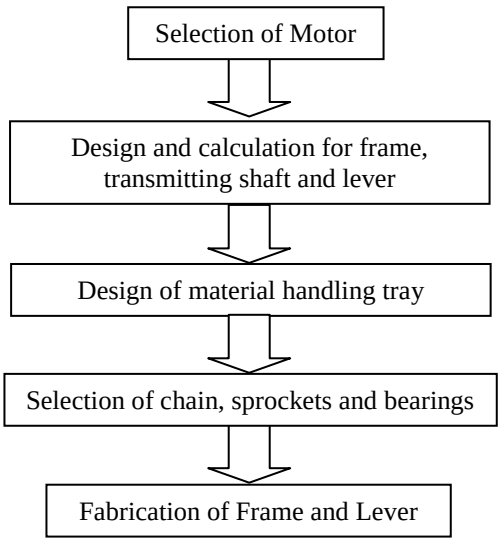

Figure 2. Methodology for Retrieval Mechanism [4]

Figure 2 shows the methodology for Design and fabrication of retrieval mechanism. The retrieval mechanism is operated with the help of chain drive mechanism which powered by electric motor and gear box in order to maximize material storage. For achieving the maximum storage the distance between the trays must minimum. And ease the process of storing and retrieving the material.

The following methodology is used for retrieval mechanism which carry maximum load of 500 kg.
The retrieval mechanism consist of following component

1) Main Frame
2) Electric motor with gearbox
3) Chain drive for power transmission
4) Transmission shaft
5) Lever
6) Material handling tray

III FUNCTIONAL ASPECTS

Functional aspects of various components used in the assembly are illustrated as below.

a) Motor :

The main function of the motor is to move the material handling tray along with load at desired location according to the user requirement.

b) Metal Frame

The metal frame supports all the elements of the system. The sprockets of the chain drive are to be mounted on the frame with the help of bearing. Material used for the frame is MS hollow sections. Dimension of material is 100 x 50 mm.

Frame Dimension after the design calculations are as follows:

i. Length = 2606mm
ii. Width = 1150 mm
iii. Height = 465 mm

c) Material Handling Tray

The material handling tray will be carrying the load i.e. all the products will be stored in them. Material selected for material handling tray is Galvanized Iron (GI) so as to make the tray lighter. The dimension of tray is 2500 X 800 X 2mm. the height of the tray is 45mm. The weight of the tray is 110kg. The maximum load that each tray carries is 500kg.

d) Chain Drive

Storage and retrieval of tray the chain drive is used and based on the design calculation following chain is selected.

Specifications of the selected sprockets are shown following table.

Table 1 Specification of roller chain

ISO chain No.	Pitch P (mm)	Load capacity (kgf)
08B-1	12.7	1820

Table 2 Specification of the sprocket

Dimension	Notation	Value	
Sprocket type	Duplex	10Teeth	13 Teeth
Pitch Circle Diameter	D	41.28mm	52.83mm
Tooth width	B	25 mm	28 mm

e) Design of Shaft

Main function of shaft is to transmit the power from gearbox to the mechanism of chain. The external load on the shaft is 2943N.

And also the force act by gearbox is 5265.79 N

By calculation the shaft diameter is 33.33mm.

f) Design of Lever

Design of lever for pushing and pulling of tray depends upon load on the tray. It is done with the help of CATIA V5 and ANSYS software.

For designing of the lever some values are assumed.

i. Mass of the tray : 500 kg (including the weight of component which are placed in tray)
ii. The mass on lever is half of the total mass of tray that is 250 kg
iii. While designing 300 kg load is considered (which is more than the actual load on lever)
iv. Considering a bell crank lever for retrieval mechanism.
v. Retrieval lever design is done according to the standard bell crank lever design procedure.

Design of Fulcrum Pin:

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Given,

F=300 x 9.81 =2943N

l_1 = 140 mm.

l_2 = 130 mm.

By calculation,

$$d_p = 20 \text{ mm}$$

$$l_p = 25\ mm$$

From this decide the dimension of boss

$d_i = 26\ mm$

$d_o = 40\ mm$

Design of Lever Cross-section:

The Cross-section of the lever is subjected to bending moment.

By bending moment calculation

$t = 15.03\ mm$

$b = 30\ mm$

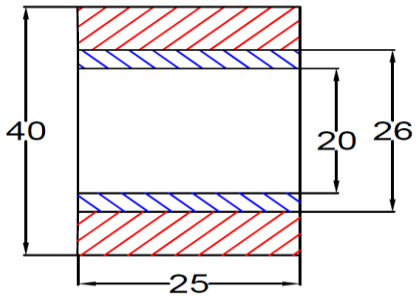

Figure 3 boss dimensions

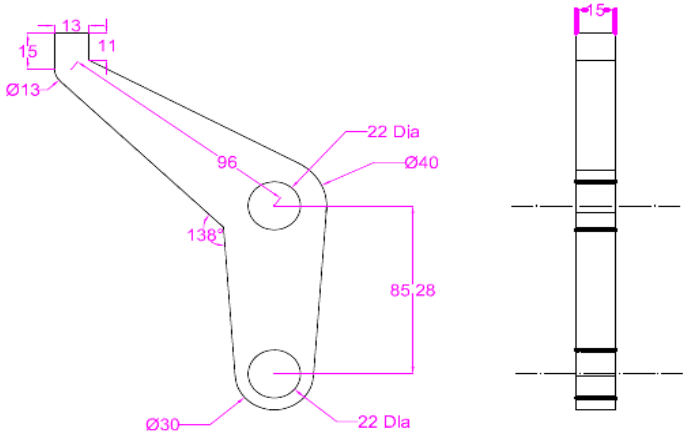

Figure 4 Lever Cross-section

IV CONSTRUCTION AND WORKING

Figure 5 shows the assembly of retrieval mechanism. Frame is the main skeleton support for the entire system. Four bolted bearing is mounted on the frame on which the10 And 13 Teeth duplex sprockets are mounted. Each side of main frame consists of 10 bearings and sprockets. Sprockets on each side are driven by double strand roller chain. The lever is attached to the roller chain with the help of pin. Electric Motor is mounted on bottom of frame with gearbox. The power transmitting shaft is connected to gearbox with the help of single strand roller chain.

The power is transmitted from electric motor through gearbox to the transmitting shaft. This shaft rotates the middle sprocket of the chain assembly. This will rotates the chain assembly along with lever. When chain rotates clockwise and anticlockwise the pushing and pulling of the tray will be done with this mechanism.

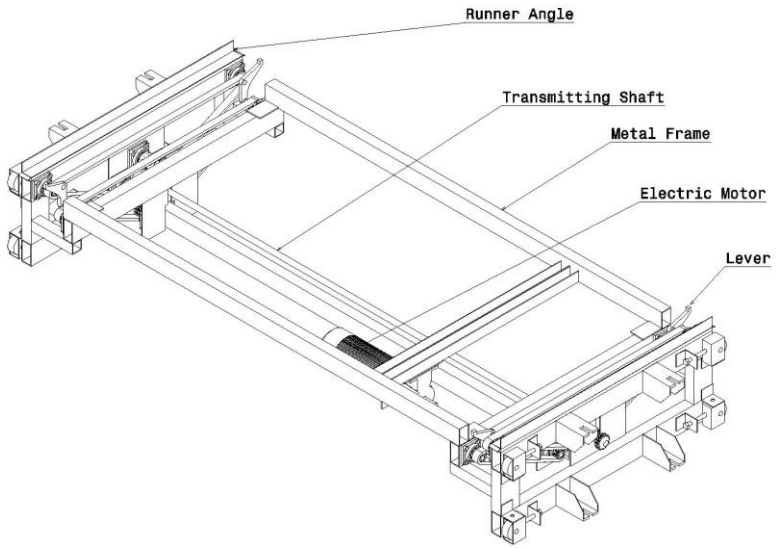

Figure 5 Assembly of Retrieval Mechanism

V FABRICATION

5.1 Fabrication Process:

The fabrication processes for components are as follows

1. Fabrication of frame: The MS hallow section are made up of 2.5mm thickness sheet. Initially the sheet is cut on cutting machine of having length 1150mm X 200mm. Then this sheet is bending in C Shape, this same procedure is carried out for length 2155mm, 200mm, 2486mm. so in order to make a hollow section, two c Sections welded together.
2. Mountings of Bearings: Four bolted bearings are mounted on holes drilled on the frame at their respective position. 11 bearings are mounted on each side. Two for supporting the sprockets on the transmitting shaft while remaining to mount the sprockets driving the chain.

3. Mountings of Sprockets: In this construction four sprockets are mounted on shaft and 18 sprockets are mounted on frame. In that Six 13 teeth sprockets and sixteen 10 Teeth sprockets are used. These sprockets are duplex having pitch 12.7mm. These sprockets are mounted on the bearings with the help of shaft having diameter 20 mm and length 60mm by shaft key.
4. Chain: ISO 08B1 chain. The length of chain 10500mm and 0.5 inch pitch are used. One side assembly of chain requires 2625 mm length of chain. Same length chains are required in four numbers. A chain of length 850mm is used to connect gearbox sprocket to transmitting shaft sprockets.
5. Frame for Motor and gearbox: a frame for placing the motor and gearbox made from MS Channels. A pallet is drilled with holes 10mm diameter to bolt the gearbox to the frame.
6. Lever: The lever is made up of Mild Steel of thickness 15mm. This is cut on laser profile cutting machine.
7. Material Handling Tray: The material handling tray is made up of GI material.. the tray is made on CNC bending machine of dimension 2600 X 890 X 45mm. the thickness of tray is 2.5mm.

5.2 Component Specification List

The components are designed and fabricated. The component specifications are shown in table 3

Table 3 Component Specification List

Sr. No.	Component	Specification
1	Motor	3phase, 2 HP flange mounting, 1440RPM
2	Gearbox	AS 25 p 16.42 p 90 B3 Bonfiglioli 2 HP suitable
3	Frame	MS, 2.5 mm hollow sections
4	Material handling Tray	GI, 2.5 mm sheet metal
5	Sprockets	0.5 inch pitch, 10 T And 13 T duplex
6	Chain	ISO 08B1(11m)
7	Transmitting shaft	Rigid MS round bar of 25 mm diameter
8	Adler shaft	Rigid MS Round bar of 20 mm diameter
9	Four Bolted Bearing	UCF 204 (16No.)and UCF 205(6No.)
10	Sheet metal	MS and GI , 2.5 mm Thick

VI CONCLUSION

The retrieval mechanism designed, analyze and fabricated for maximize the storage of material by reducing the distance between two trays. The distance between two trays is reduced by this mechanism.

VII ACKNOWLEDGEMENT

I would like to express our sincere gratitude to Prof. M. B. Mandale Department of Mechanical Engineering, for his guidance and help extended at every stage of this project work. I am deeply indebted to him for giving us a definite direction and moral support. His valuable suggestions and co-operative nature during the course of present investigation would remain encouraging throughout our life.

I am also thankful to my respected HOD Dr. S. K. Patil, Department of Mechanical Engineering, for extending support to complete the paper effectively.

I wish to thank other faculty members of the Department of Mechanical Engineering, Rajarambapu Institute of Technology, sakharale for their valuable advice in every stage for successful completion of this paper.

Finally, I would like to thank my parents for their trust they have shown on me. I am also thankful to all of my well-wishers.

REFERENCES

[1] Jainil Prajapati et al. "Automated Storage And Retrieval System For Educational Purpose- A Review." International Journal of Advances in Electronics and Computer Science Vol. 4 (2017): pp. 63-67.

[2] Jainil Prajapati et al. "Implementation of Vertical Automated Storage and Retrieval System in Library." Imperial Journal of Interdisciplinary Research (IJIR) Vol. 3 (2017): pp. 1261-1267.

[3] Tone Lerher. "Design of Experiments for Identifying the Throughput Performance of Shuttle-Based Storage and Retrieval Systems." 10th International Scientific Conference Transbaltica Transportation Science and Technology Procedia Engineering 187 (2017): pp. 324-334.

[4] Girish Dalvi And Sanjay Rukhande. "Automated Storage & Retrieval System." International Research Journal of Engineering and Technology (IRJET) Vol. 4 (2017): pp. 653-658.

[5] Antonio Gabriel-Santos "The rational footsteps for the design of the mechanism of a vertical carousel-type storage device." The 10th International Conference on Axiomatic Design. Procedia CIRP 53 (2016): pp. 193-197.

[6] Priti kumari et al. " Automatic Storage and Retrieval Robot Using Embedded System" International Research Journal of Engineering and Technology Vol. 3 (2016): pp. 1554-1556.

[7] Garg Uttam et al. "Vertical Material Handling System." International Journal of Mechanical Engineering and Technology (IJMET) Vol. 6 (2015): pp. 19-29.

[8] Simon Brezovnik et al. "Optimization of an Automated Storage and Retrieval Systems by Swarm Intelligence." 25th DAAAM International Symposium on Intelligent Manufacturing and Automation Vol. 100 (2015): pp. 1309-1318.

[9] Amine Hakim Guezzen. "Travel Time Modeling and Simulation of a Mobile Racks Automated Storage/Retrieval System." IACSIT International Journal of Engineering and Technology, Vol. 5 (2013): pp. 420-423.

[10] Smita U.Chakole. " Development of Robotic Automated Storage and Retrieval System (AS/RS)." International Journal Of Computational Engineering Research (ijceronline.com) Vol. 3 (2013): pp. 36-40.

[11] Dinkar Nandwana et al. "Design, Finite Element Analysis and Optimization of HRC Trays used in Heat Treatment Process." Proceedings of the World Congress on Engineering 2010 Vol 2 (2010)

[12] Web-Link-https://google.co.in/automatic+storage+and+retrive+system.