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FABRICATION OF RADIAL TYPE SHIP LOADER

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ABSTRACT
Loading of bulk materials like iron ore, coal, fertilizers, grains into ships for transportation by sea is done by ship loaders. Ship loaders are a very common sight in ports and jetties from where bulk materials are exported. It mainly consists of an extendable boom, a belt conveyor and a mobile structure to support the boom. It is usually mounted on rails and sometimes on tires and can move in order to be able to reach the whole length of the ship. The boom also can move front and back (boom telescoping), up and down (luffing) by separate drives so that it can fill all the corners of the ship hatches. Ship loaders are built in capacities from 1000 to 15000 TPH (tones per hour). The height of a ship loader can be in excess of 20 meters and the boom can extend to a length of more than 60 meters. Arc type of ship loaders are usually mounted on a pair of rails that are parallel to the berth and the ship. This type of ship loader can perform operations like long travel, luffing and slewing movement of the boom to reach maximum portions the ship hatch area. This type of ship loaders are less common in present day ports as it cannot load material to all portions of the ship hatches, requires huge berth construction work and more number of conveyors A Linear ship loader is usually mounted on a pair of rails that are parallel to the berth and the ship. This type of ship loader can perform operations like long travel, luffing and telescopic movement of the boom to reach all portions of the ship hatch. We propose a machine called radial ship loader which is capable of loading 1000's of tons of bulk material in to ships and can considerably reduce civil work for berth, power consumption and number of conveyors required for operation.

KEYWORDS: ship loaders, belt conveyor, boom, , luffing and telescopic, radial ship loader, ship hatch.

INTRODUCTION
A Ship loader is a huge machine used for loading bulk solid materials like iron ore, coal, fertilizers, grains into ships for transportation by sea. Ship loaders are a very common sight in ports and jetties from where bulk materials are exported.It mainly consists of an extendable arm or boom, a belt conveyor and a mobile structure to support the boom. It is usually mounted on rails and sometimes on treys and can move in order to be able to reach the whole length of the ship. The boom also can move front and back, up and down by separate drives so that it can fill all the corners of the ship holds. Ship loaders are built in capacities from 1000 to 15000 TPH (tones per hour). The height of a ship loader can be in excess of 20 meters and the boom can extend to a length of more than 60 meters.A Mobile High Angle Ship loader can be found in the Port of Adelaide, Australia. The mobile sandwich belt "Snake" is carried on a tripod of twin motorized rubber tires. Each set of twin tires is mounted at a vertical kingpin and can rotate 360 degrees about that vertical axis. Thus, without repositioning, it can set up to travel in any direction. With the tail tires fixed, the front tires can be oriented and traveled for a slewing motion. Australia's first Snake Ship loader elevates a variety of high value ores from trucks to ship at an angle of 50 degrees. Materials for export are trucked to the dock and dumped onto a special trap loader type feeder. The ore is fed continuously and uniformly onto the mobile snake's receiving chute. The snake ship loader elevates the bulk over the ship's deck to the hatch where it is discharged into the ship's hold. At the discharge, a special telescoping chute, with rotating, pivoting spoon, facilitates even and complete filling of the holds..

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CONVENTIONAL TYPE SHIP LOADERS

ARC TYPE SHIP LOADER: Arc type of ship loaders are usually mounted on a pair of rails that are parallel to the berth and the ship. This type of ship loader can perform operations like long travel, luffing and slewing movement of the boom to reach maximum portions the ship hatch area This type of ship loaders are less common in present day ports as it cannot load material to all portions of the ship hatches, requires huge berth construction work and more number of conveyors

LINEAR TYPE SHIP LOADERS: A Linear ship loader is usually mounted on a pair of rails that are parallel to the berth and the ship. This type of ship loader can perform operations like long travel, luffing and telescopic movement of the boom to reach all portions of the ship hatch. Though this type of ship loaders are most commonly used in Indian ports they require huge construction work for berth, more number of conveyors and high power consumption

IMPORTANCE: Plant layout is an important decision as it represents long-term commitment. An ideal plant layout should provide the optimum relationship among output, floor area and manufacturing process. It facilitates the production process, minimizes material handling, time and cost, and allows flexibility of operations, easy production flow, makes economic use of the building, promotes effective utilization of manpower, and provides for employee's convenience, safety, comfort at work, maximum exposure to natural light and ventilation. It is also 99 important because it affects the flow of material and processes, labor efficiency, supervision and control, use of space and expansion possibilities etc

LITERATURE REVIEW

1. An investigation into design and manufacturing of mechanical Conveyors Systems for food processing. S.H. Masood, B. Abbas, E. Shayan, A. Kara This paper presents a application of concept of concurrent engineering and the principles of design for manufacturing and design for assembly [4, 5],several critical conveyor parts were investigated for their functionality, material suitability, strength Criterion, cost and ease of assembly in the overall conveyor system. The critical parts were modified and redesigned with new shape and geometry, and some with new materials. The improved design Methods and the functionality of new conveyor parts were verified and tested on a new test conveyor System designed, manufactured and assembled using the new improved parts. The improved methodology for design and production of conveyor components is based on the minimization of materials, parts and costs, using the rules of design for manufacture and design for assembly. Results obtained on a test conveyor system verify the benefits of using the improved techniques. The overall material cost was reduced by 19% and the overall assembly cost was reduced by 20%compared to conventional methods

.2. Latest Developments in Belt Conveyor Technology M. A. Alspaugh, Overland Conveyor Co., Inc.This paper presents latest development in belt conveyor technology & the application of traditional components in non-traditional applications requiring horizontal curves and intermediate drives have changed and expanded belt conveyor possibilities. Examples of complex conveying applications along the numerical tools required to insure reliability and availability will be reviewed. This paper referenced Henderson PC2 which is one of the longest single flight conventional conveyors in the world at 16.26 km. But a 19.1 km conveyor is under construction in the USA now, and a 23.5 km flight is being designed in Australia. Other conveyors 30-40 km long are being discussed in other parts of the world.

3. Availability modeling of powered roller conveyers John R. English, University of Arkansas, John Usher University of Louisville This paper provides an analysis of the reliability and availability of two common designs of the line-shaft roller conveyor. The first is a standard design in which each roller is belted directly to a spinning line shaft under the conveyor. The second is a new design in which only one top roller is belted to the line shaft, and all other rollers are belted to the one powered roller in a series arrangement. The main reason for this design is that the upper belts are faster to replace than belts connected to the line shaft, thus increase Sing system availability. However, the latter design is less reliable in that the failure of a single belt may lead to multiple roller failures.

4. Modeling power & free roller conveyor system Dev P. Sathyadev, Sanjay Upendram, Eric Grajo, Ali Gunal, Onur Ulgen Production Modeling Corporation. This paper establishes the groundwork to model power and free conveyor systems using AutoMOD II simulation software. A methodology to identify and model system parameters, control and routing logic, and sequencing product mixes is developed. A description of pitfalls, work-around, and other issues of concern in using Auto MOD to model power and free systems is presented. Recommendations for future enhancements and a comparison of power and free systems with state-of-the-art movement systems conclude the paper.

5. Development of concept design CAD system C. Sekimoto Energy and Mechanical Research Laboratories, Research and Development Center Toshiba Corporation. In order to shorten the product development time and improve the product quality, 3 dimensions at CAD/CAE system is essential. It is necessary to develop a system which utilizes the concept design data at the early stage for the whole process of the product development. The purpose of this project is to improve the product quality by the sufficient design study iteration at the early stage of design. A CAD system which can be used for the concept design and an appropriate CAD environment should be developed. And another purpose is to shorten the product development time at the late stage of design.
6. Survey of research in modeling conveyor-based automated material handling systems in wafer Fabs Dima Nazzal, Ahmed El-Asher Department of Industrial Engineering and management Systems, University of Central Florida. This paper discusses literature related to models of conveyor systems in semiconductor fabs. A comprehensive overview of simulation-based models is provided. We also identify and discuss specific research problems and needs in the design and control of closed-loop conveyors. It is concluded that new analytical and simulation models of conveyor systems need to be developed to understand the behavior of such systems and bridge the gap between theoretical research and industry problems.
As discussed so far the plant layout facilitates the arrangement of machines, equipment and other physical facilities in a planned manner within the factory premises. An entrepreneur must possess an expertise to lay down a proper layout for new or existing plants. It differs from plant to plant, from location to location and from industry to industry. But the basic principles governing plant layout are more or less same. As far as small business is concerned, it requires a smaller area or space and can be located in any kind of building as long as the space is available and it is convenient. Plant layout for Small Scale business is closely linked with the factory building and built up area. From the point of view of plant layout, we can classify small business or unit into three categories:
1. Manufacturing units, 2. Traders, 3. Service Establishments
When two outlets carry almost same merchandise, customers usually buy in the one that is more appealing to them. Thus, customers are attracted and kept by good layout i.e. good lighting, attractive colors, good ventilation, air conditioning, modern design and arrangement and even music. All of these things mean customer convenience, customer appeal and greater business volume. The customer is always impressed by service, efficiency and quality. Hence, the layout is essential for handling merchandise, which is arranged as per the space available and the type and magnitude of goods to be sold keeping in mind the convenience of customers.
There are three kinds of layouts in retail operations today.
1. Self service or modified self service layout 2. Full service layout 3. Special layouts
The self-service layouts, cuts down on sales clerk's time and allow customers to select merchandise for themselves. Customers should be led through the store in a way that will expose them to as much display area as possible, e.g. Grocery Stores or department stores. In those stores, necessities or convenience goods should be placed at the rear of the store. The use of color and lighting is very important to direct attention to interior displays and to make the most of the stores layout. All operations are not self-service. Certain specialty enterprises sell to fewer numbers of customers or higher priced product, e.g. Apparel, office machines, sporting goods, fashion items, hardware, good quality shoes, jewelry, luggage and accessories, furniture and appliances are all examples of products that require time and personal attention to be sold. These full service layouts provide area and equipment necessary in such cases. Some layouts depend strictly on the type of special store to be set up, e.g. TV repair shop, soft ice cream store, and drive-in soft drink stores are all examples of business requiring special design. Thus, good retail layout should be the one, which saves rent, time and labour.Materials handling systems provide transportation and storage of materials, components and assemblies. Material handling activities start with unloading of goods from delivery transportation, the goods then pass into storage, onto machining, assembly, testing, storage, packaging, storage, and finally loading onto transport. Each of these stages of the production process requires a slightly different design of handling equipment, and some processes require integration of multiple items of handling equipment .Design or selection of the right material handling system is one of the most important decisions that a manager can make, because of the effects on the rest of the manufacturing plant. It affects the material flow and the factory layout. Apart from the initial capital cost for a new system, the consequences of any misjudgment in material handling will have considerable and long-term effects on operations. In recent years computer based simulation tools have been developed to simulate material handling systems and their effect on the manufacturing process. Loading equipment is aimed at providing the capability to load and unload vehicles; it is also referred to as loading bay equipment. The category can be divided into products that provide access from the loading bay to the vehicle and equipment that moves the product from the loading bay to the vehicle and vice versa. Equipment that falls into the access category are

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scissor lifts, goods lifts, dock levelers, loading ramps, doors, dock seals and vehicle restraints, and equipment that falls into the movement category are pallet trucks, conveyors and fork lift trucks.

OBJECTIVE OF THE PROJECT

The radial-type ship loader features a fix bridge-type structure that pivots around a kingpin-type support, while the seaward side is supported on a series of bogies that travel along a circular rail. A telescoping boom traverses the top of the main structure, complete with telescoping loading chute and spoon. The extent of travel of the telescoping boom depends on the angle of rotation of the main structure to ensure access to each hold of the ship. By pivoting at the tail end, the ship loader is afforded access to the entire length of the ship. Rather than incorporating a shuttle conveyor, the entire upper structure travels on the fixed lower bridge section of the ship loader. The combination of bridge rotation and boom travel allows the operator to access all areas of the ship's hold.Ship loader or Ship loader is designed as one of the port material handling equipments that is used for loading different sizes of vessels berthing at ports continuously with coal, iron ore, cement, grain and other bulk materials. Normally belt conveyors are used in ship loading equipments in a continuous action to move bulk material product from dock conveyors onto the vessels. A radial ship loader incorporates a pivot point at the dock side end which allows the ship loader to access the full length of the ship. The lower part of the ship loader is fixed in a bridge section. The upper structure travels on the bridge section allowing the boom to extend to provide coverage of the different areas of the ship's hold.The quadrant-type radial type ship loader features a fix bridge-type structure that pivots around a kingpin-type support, while the seaward side is supported on a series of bogies that travel along a circular rail. A telescoping boom traverses the top of the main structure, complete with telescoping loading chute and spoon. The extent of travel of the telescoping boom depends on the angle of rotation of the main structure to ensure access to each hold of the ship. By pivoting at the tail end, the ship loader is afforded access to the entire length of the ship

Fig: 1 a fix bridge-type structure

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Fig 2: Carrying Idler

Fig: 3 Return Idler

The most commonly used type of carrying idlers used for handling bulk load consist of three in line idler rolls of equal length. The three equal length roll toughing idlers form the belt into the best troughed shape to carry a maximum load cross section. For handling unit load or for handling nominal bulk load, or for supporting belt in return side, straight idlers are used, positioned between brackets attached directly to the conveyor frame. Another type of carrying idlers is used at the loading points where the lump size and the weight of the material ma seriously damage the belt if the belt were rigidly supported. Such idlers are called impact idlers.

Fig: 4 Pulley

Fig: 5 Belt Conveyor

These form the rotating devices in the conveyor these help in transmitting the motion of the motor to the conveying belt, these act as both support and end points for the conveyor, the pulleys are mounted on the shaft of the motors and these rotate combined with the motor shaft and in turn rotate the belt that is mounted into them

There are two types of pulleys,

1 .Drive pulley   2. Driven pulley

The function of both of them is the same i.e. to transfer the rotating motion to belt and make the belt pass over it, the difference occurs only in the input, only the driving pulley is given the input whereas the driven pulley just rotates freely and pushes the belt forward our pulleys are machined out from wood to reduce the Weight, thereby reducing the load on the motor. The dimensions the pulley we have machined is 60mm in length and 40 mm diameter. A conveyor belt System consists of two or more pulleys, with a continuous loop of a belt that rotates about them. The pulleys help the conveyor belt move and the material on the belt is thus forwarded from the input point to the output. There are two main industrial classes of belt conveyors. First is general material handling such as those moving food products, other products, or unprocessed or under process products, finished unpacked products, boxes etc… along inside a factory. Second is bulk material handling such as transporting industrial and agricultural materials, or solid fuels such as grain, coal, ores, husk, etc. generally in outdoor and longer areas. In addition there are a number of commercial applications of belt conveyors such as those in restaurants. Boom is the complete structure formed combining all the conveying systems in other words Boom is the housing of all the conveying components. There are two booms in the machine; one is the long boom which is placed in the ground and the other id the luffing boom which can luff about 40o in vertical direction. The ***boom*** material is made up of aluminum again and the complete conveying system is housed into the boom by helps of fitting arrangements. The dimensions of our booms are, the long ground boom if 100 cm

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in length and the height is 6 cm and the width being 7.25 cm. the bucket wheel is setup on to one end of the smaller boom and the other side is hinged for luffing motion.

RESULTS AND DISCUSSION

Design & Calculations.

Designs of Components

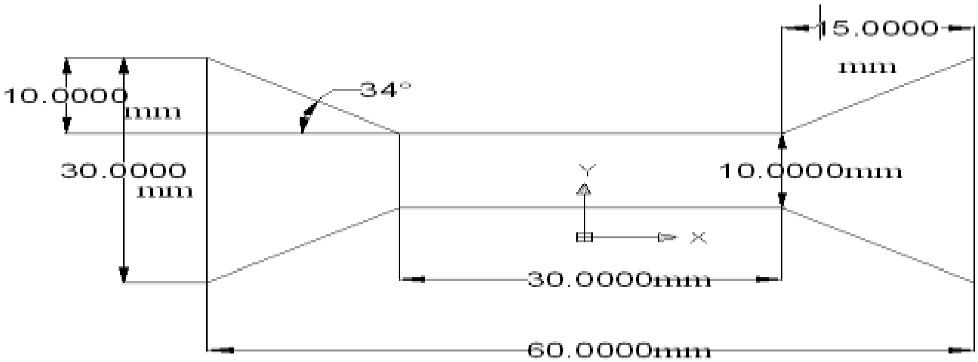

Fig: 6 Designs of Components of Idler

TABLE 1; CONVEYOR CALCULATIONS

Description	Unit	Value
Mass flow	kg/hr	49.00
Area	Sqm	0.0006
Bulk density	Kg/Cum	800.00
Velocity	m/hr	111.36
Velocity	m/min	1.86
Pully Dia	mm	40.00
Circumfrance	mm	125.60
Speed of Drive Pully	r.p.m	14.78
Power calculation		
Mass of the belt	kg	0.05
mass of the idlers	kg	1.08
Mass of material	gm	528.00
Mass of material	kg	0.5280
coefficient of belt friction "u"		0.40
F	n-m	6.49
Power	W	0.3000
Motor Selected		
Power	W	1.00
Voltage	v	12.00
Current	Milli A	83.33
Speed	r.p.m	15.00
Motor choosen	W	1.00

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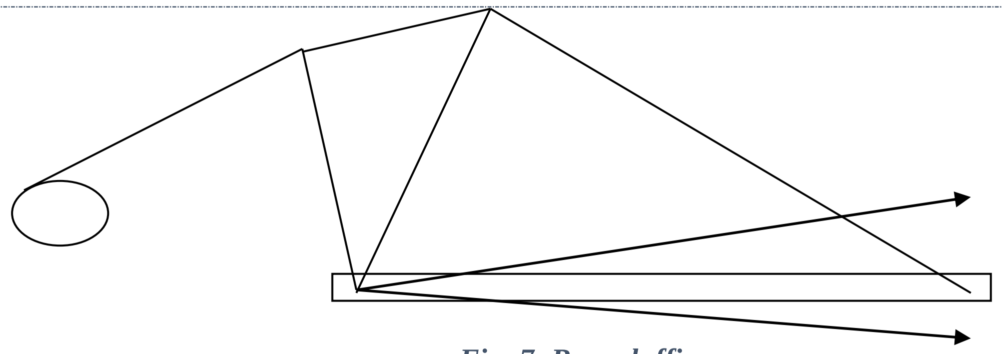

Fig: 7: Boom luffing

TABLE: 2 Boom luffing Calculation

Power calculation		
Mass of the boom	kg	2.00
F	n-m	19.62
Velocity	m/s	0.04
Power	W	0.8214
Motor choosen	W	1.00
Motor Selected		
Power	W	1.00
Voltage	v	12.00
Current	Milli A	83.33
Speed	r.p.m	10.00

TABLE 3: BILL OF MATERIALS (BOM)

SL.NO	DESCRIPTION	UNITS	VALUE
1	Pulley	mm	4()
2	Idlers	mm	30
3	Bearing	mm	1
4	Aluminium Metal Piece	mm	2
5	D.C Motors	rpm	5
6	Belt	mm	1
7	Ms Sheet	mm	1
8	Ms Rod	mm	1
9	Nutts&Bolts	no	100
10	Spokes	no	2
11	L Brackets	no	1
12	Wooden Wheels	no	5
13	Battery	volts	1
14	Electric Wires	m	4
15	Switches	no	4
16	Switch Board	no	1

DESIGN & CALCULATIONS

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We have the following formulae to calculate the power on conveyor motor

i. M=length of belt*mass of load per meter
ii. F= u(M+mass of belt+mass of idlers)*g
iii. P= (F*V)/1000

M=length of belt (1.1)*mass of load (0.398)

M=0.4378

Mass of idlers: mass of carrying idler =25gms, mass of return idler = 15gms
No of carrying idlers=20, no of return idlers=18
Hence total mass of idlers = (25*20)+(15*18)=750gms
Mass of belt =100gms
U=0.33 coefficient of belt friction
F=0.33(0.4378+0.75+0.1)*9.81

F=5.7623 n-m

Power (p)=(5.6723*0.628)/1000 = 3.61watts.

Degrees of luffing = 30˚

(10˚ down & 20˚ up)

Distance of rope movement=2πr÷360×30

=π×20÷6

=10.46

Scope of distance from centre'x'

2π×19÷360×X = 10.46

x = 31.55

Scope of distance from centre'y'

2π×17÷360×y = 10.46

Y = 35.2

Scope of distance from centre'z'

2π×17÷360×y = 10.46

Z = 149

No of rotations of motor for 30˚ luffing = 149÷360

= 0.413

CONCLUSION

The radial-type ship loader features a fix bridge-type structure that pivots around a kingpin-type support, while the seaward side is supported on a series of bogies that travel along a circular rail. A telescoping boom traverses the top of the main structure, complete with telescoping loading chute and spoon. The extent of travel of the telescoping boom depends on the angle of rotation of the main structure to ensure access to each hold of the ship. By pivoting at the tail end, the ship loader is afforded access to the entire length of the ship. It mainly consists of an extendable boom, a belt conveyor and a mobile structure to support the boom. It is usually mounted on rails and sometimes on tires and can move in order to be able to reach the whole length of the ship. The boom also can move front and back (boom telescoping), up and down (luffing) by separate drives so that it can fill all the corners of the ship hatches. It can considerably reduce civil work for berth, power consumption and number of conveyors required for operation.

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