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DESIGN FOR AUTOMATION FOR CAM CHAIN TRANSFERING INTO END RIVETING MACHINE

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Abstract: Need for automation has become the utmost priority in modern industries which in turn reduces the rate of rejection and increase the production.TIDC (Tube India Dimensional chain) is a classic example of modern industry which manufactures drive and CAM chains for Indian manufactured motor cycles (for HERO, BAJAJ, ROYALENFIELD etc).

Four basic components are involved in assembling these chains and they are inner/outer plate, bush, pin, roller. A pitch cutting machine is used to get a required length/pitch of the manufactured chain where the continuous chain is cut into a required pitch based on the model of the chain. During the operation the outer plate at the cutting zone is de-riveted and the separated. The above mentioned process is done by the integration machine. The next operation is loading the chain into the end riveting machine done by the operator. As the transfer of the chain into end riveting machine is done manually with the help of the operator. Here the organization is facing problem like improper loading of the chain which results in rejection, irregularity in the attendance of the operator which cut downs the production, regular injuries caused to the operators during loading the chain. To eliminate such issues the organization has approached our company to automate the loading of the chain into end riveting machine. The aim of this project is to design and develop a model where automatically the transfer of the chain from integration machine to end riveting machine without human involvement.

Index Terms **– Automation, cam chain, riveting machine**

I. INTRODUCTION

The ever growing demand for high levels of production along with scarcity of skilled workers and fall in efficiency has forced the manufactures to look at other alternatives. Due to this, the need for automating their process is of utmost importance for achieving high productivity, high reliability, high consistency and high accuracy. Other main factors for adopting automation are removing workers from dangerous work procedures in order to reduce the risk of injuries. Automation not only reduces repetitive physical work but also enables the organizations to use workforce elsewhere in a better way. Need for automation substituting human participation and manual process is the area where modern industries are looking for. The broad range of project includes transformation of manual process to automation.

II. OBJECTIVES AND REQUIREMENTS

A. Understand in which area there is a need to replace manual process to automation where repetitive work is done. Look at the manual process that is carried out at the customer location. Find out the inputs given to the machine.

B. Designing a machine where it will automatically carry forward all the process without any human involvement and human supervision. Design a conceptual design and take approval from the customer which is later converted into final assembly machine.

C. Using control systems for all the actions to happen automatically, where in pneumatic cylinders, servo motors and electrical PLC will be used for controlling actions. List out what all actions are required as well select the apt actuators and its support and control systems.

D. After the final review of the design and screening of the design aspects release for manufacturing.

Actual requirement is to joining of pitch cut CAM chain where in top plate loading, sizing and riveting is done in semi-automated end riveting machine where an operator loads the pitch cut CAM chains into the machine. Operator has to load 1200 chains per shift, here is the actual requirement of automating the loading operation.

III. REQUIREMENT BY THE CUSTOMERS

Automation for transfer and loading of CAM chain from integration machine to end riveting machine which is presently done manually with the help of operator. The basic idea for the requirement is to obtain precised transfer of chain without human involvement or an operator. As well to increase the production rate which will automatically happen when a human is replaced with machine which

works automatically. Design and develop a machine which can be easily maintained and operated by even a semi-skilled labour. Provide with adjustment for various chain models that are 8 counter and flat Counter chains as well different number of link s chain models. The machine should be pneumatically and electrically operated and not to use hydraulics.

Fig.1 Manual chain transfer and loading

Fig.2 Main parts of Chain

A chain is the assembly of different parts involving outer plate, inner plate, bearing pin, bush and roller. All the specifications were provided by the customer, which I cannot disclose into this project report basing on our organization rules.

Fig.3 8Counter chain (plates are in 8 shape)

Fig.4 Flat counter chain(plates are in flat shape)

Table.1. Different chain links

S.no	8 counter chain	Flat counter chain
1	62(links)	62
2	82	80
3	84	84
4	88	88

Customer has a requirement where the machine should be provided with adjustment to the different models and number of links as stated above in table-1. The difficulties faced during manual loading are: improper loading of the chain, mainly the center of the chain where riveting takes place which leads to rejection of that particular chain, injuries caused during loading of the chain into the end riveting machine, irregular attendance of the operator which leads to cut down in production rate, an automatic machine will eradicate the above mentioned difficulties. The production rate / hour shift as per the inputs provided by the customer, each operator's efficient working average hours is to be 6 hours a shift and each operator manufactures 200 chains per hour.

Fig.5 Output shape of chain from the integration machine

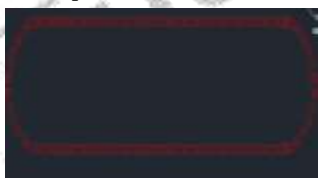

Fig.6 Input chain formation for end riveting machine

IV. TECHNICAL REVIEWS OVER THE INPUT

As per the inputs provided by the customer, the following points are to be considered during the design and development.

1) For handling the chain, the area where the bush is located has to be used. The outer and inner plates should not be in contact with metal items during transition.

2) Machine to be designed where it is adjustable for the different model of chains as shown in table-1.

3) The production data provided by the customer for single shift.

One operator - shift production (6 hours) - 1200 chains
Required production rate for shift - 1500 chains
For one hour- 200 chains and for one second - 3 chains

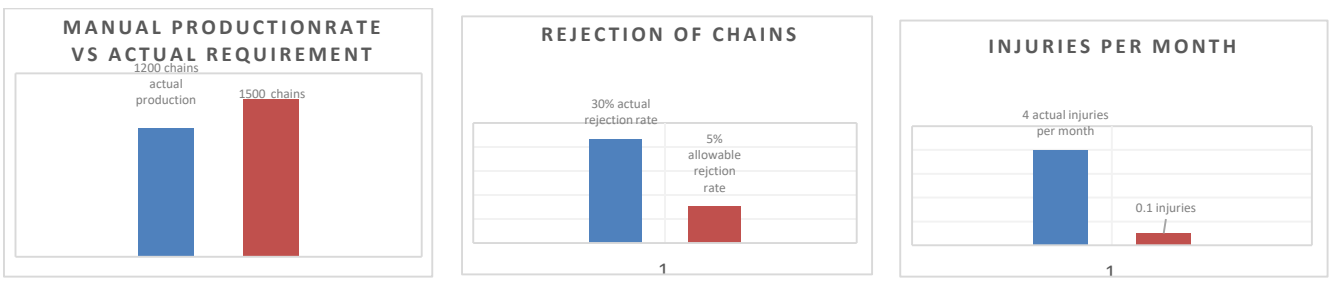

Fig.7 Graphs

The various graphs show manual production rate vs actual requirement, rejection rate per production allowable - 5% of the total production vs actual rejection rate -30% of the total production and injuries per month- 0.1vs actual injuries per month- 4.

V. CONCEPTUAL DESIGN

Keeping all the inputs given by the customer, a conceptual design is prepared for the customer to review and approve for the final design. Looking at the manual operation done by the operator at the customer place we have decided to divide the machine operations into two categories.

1) Transfer of chain from integration machine to end riveting machine (transfer unit).
2) Chain formation and chain gripping unit (palm unit).

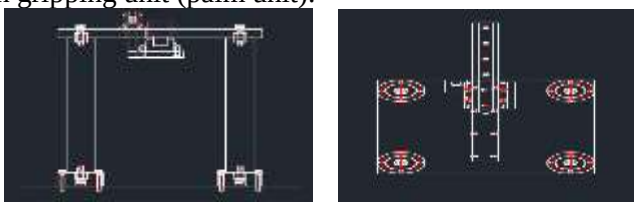

Fig.8 Transfer unit- front and top views

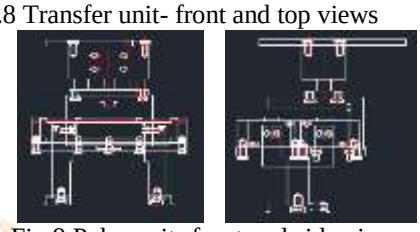

Fig.9 Palm unit- front and side views

To carry out the process the following operations are to be considered.

Operation -1: As the chain has to be transferred from one machine to other, it has to move a certain distance, which is 400mm. For this operation to happen automatically a pneumatic cylinder is used with 400mm stroke and diameter 32 bore. Load that it has to carry is not more than 100kgs so diameter 32 bore can be comfortable used.

Operation -2: Before transferring the chain it has to be lifted up to a certain height where it is free in the air and there is no collision during its travel. The height to be lifted is 20mm which was the input given by the customer. Here a guided pneumatic cylinder with diameter 25 bore and 20mm stroke is used.

Operation -3: During its travel or during its pick up the formation of the chain should not be disturbed for which we will be using two pneumatic cylinders connected both in opposite direction. A half circle fingers are used so as to maintain the eclipse shape of the chain. These fingers are connected to the pneumatic cylinders which move in opposite direction.

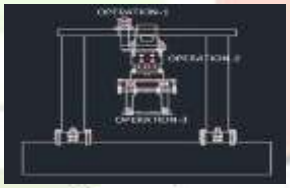

Fig.10.Machine setup working model-1

In the working of model-1, the initial position is the center of he chain. Now the operation 2 where cylinder comes down 20mm and next the fingers move in opposite direction with the help of the cylinders which is shown in operation 3, by this desired shape of the chain is obtained as shown in fig 11. After this operation the chain will be lifted up 20mm as shown in operation-2 and then transferred into end riveting machine as shown in operation-1.During the final review a query was raised by the customer as to chain's center position might shift during the operation -3. Hence there is a requirement of change in design. The design has to be in such a way where the center position of the chain should not shift. Therefore the model-1 design is not workable.

VI. DESIGN APPROVAL

After the conceptual design was reviewed by the quality and manufacturing team of the customer they asked us for some changes in design. In which they mention about travel distance to be more than 400mm which will help them maintain the machine easily. As well during travelling there should not be any disturbance in chain position. According to the changes suggested by the customer, we developed another model where we used a longer stroke cylinder to maintain the distance between integration machine and end riveting to be 400mm minimum. In order to avoid disturbances in the chain during travel we incorporated a gripper which will hold the chain in the center, with this precise center position of the chain is maintained.

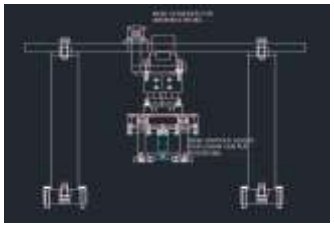

Fig.11.Machine setup working model-2

All the conceptual designs were made in AUTOCAD software as it was only for pictorial representation and for customer review. After incorporating all the changes made by the customer, the customer approved for final design and manufacturing.

VII. ASSEMBLY DESIGN

After receiving approval from the customer we have started the development of the 3d model using solid works. As mentioned in the conceptual design the machine is classified into two operations: transfer unit and palm unit.

Fig.12 Transfer unit

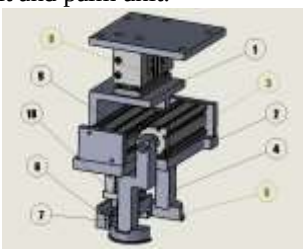

Fig.13 Palm unit

Sl.No	Part Description	Qty
1	Pillar mounting block	4
2	Pillar	4
3	Pillar spacer	4
4	Top plate	1
5	Palm slide	1
6	Palm rail support	1
7	Palm slide rib	1
8	CDQ2L32-400DCMZ A93L palm slide cylinder	1
9	HGW35HC1R450Z0C LM block & rail	1

Sl.No	Part Description	Qty
1	Up down cylinder plate	1
2	Cylinder resting plate	1
3	Side cylinder mount plate	2
4	Side cylinder arm	2
5	Side cylinder finger	2
6	Gripper finger mount plate	2
7	Gripper finger	4
8	MGPM25-20Z-A93L cylinder for lifting	1
9	CDQ2KB32-75DZ-A73L cylinders for widening	2

Fig.14 Final machine layout views 1&2

VIII. PNEUMATIC INVOLVEMENT

Pneumatic cylinders play a very important role in the automation field. They provide easy movement of the parts and help in desired operations to take place. Here is the list of cylinders that are used in this project

Fig.15 Cylinder parts : CDQ2L32-400DCMZ-A93L palm slide cylinder, HGW35HC1R450Z0C LM block & rail, 20Z-A93L cylinder for lifting, CDQ2KB32-75DZ-A73L cylinders for widening, MHZ2-20D-M9BL gripper for chain holding

IX. RESULTS AND COMPARISON

The various graphs are: the production before the automation for 6 hours is 1200 chains and the production after the automation for 6 hours is 1600 chains; the rejection rate before automation is 30% of total production and rejection rate after automation is 4% of total production; the injuries before automation is 5 per month and injuries after automation is 0.1 per month. The cycle time for automatic operation for 1 chain production is 15seconds. The blue colour indicates before automation and orange colour indicates after automation.

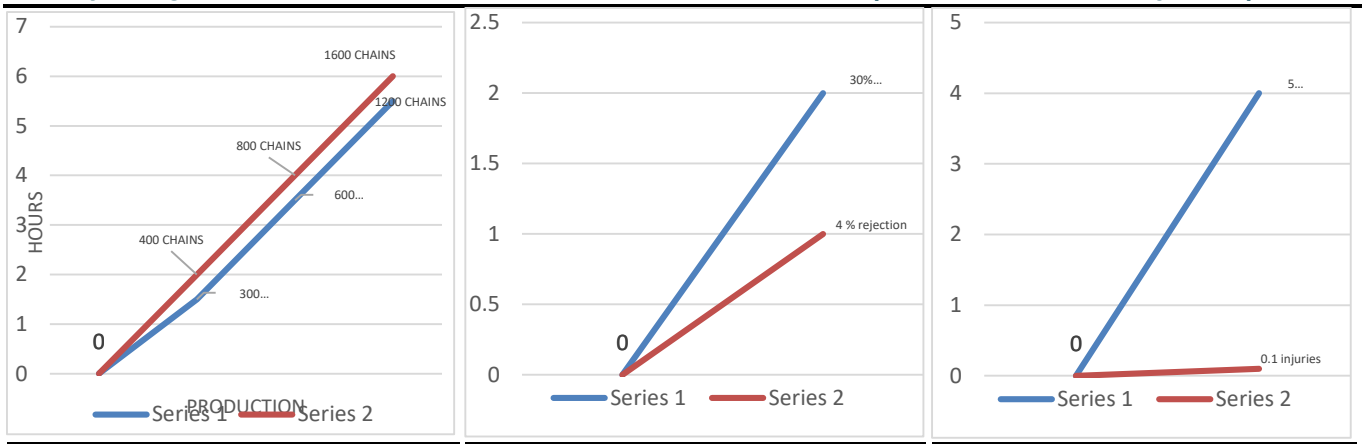

Fig.16. The various graphs before and after automation

X. CONCLUSION

The aim of the project was to design and develop an automatic machine which wills fulfill the customer requirement of transferring the CAM chain from integration machine to the end riveting machine without human involvement. A machine is designed fulfilling all requirements of customer. The design of the machine of various stages is shown above in graphs, tables, figures etc. By installing this machine at customer place the production rate will increase, percentage of chain rejection is reduced, the safety of the worker is ensured. The rate of injuries will also reduce drastically. By which this project is meeting all the stated points and it is working towards improvement.

XI. FUTURE SCOPE OF THE WORK

As all the design attributes are approved by the customer, all the part drawings are released for manufacturing. Once the manufacturing is done the order for bought out items will be placed (cylinders, LM block). Later assembly of the machine will take place and trails of the working machine will happen at our workplace. Then the customer will physically review the machine and thereafter training will be imparted to the customer on the usage of the machine and also how to maintain the machine. After the final review the machine will be dispatched to the customer location and placed in line with the assembly line and use it for production. All the above mentioned points were to be covered in the project but due to some logistics problem could not include them as it will require some more time to work on.

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