

Pneumatic Precision Dumping System

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Abstract- A dumping vessel attached to dumper that can dump the load in multiple directions using pneumatic and electric actuators. The mechanism helps in dumping the load precisely without the need to manoeuvre the vehicle. The mechanism involves pneumatic and electric components for the rotational and angular movements.

Keywords- Dumper, Dumping system, vehicle manoeuvre, pneumatic, precision.

I. INTRODUCTION

A dumping trailer is an integral part of any construction work, its role is important for completion of any constructional site. One of the problems is cited with dumper is the time and energy for setting the huge dumper in the proper direction to dump the material it is carrying and hence the need of a mechanism that can dump in multiple directions rises. A dumping trailer which can dump the material in any direction along with the forward one without moving the vehicle in any direction.

II. WORKING PRINCIPLE

The working principle of the project is 180-degree movement of the dumper vessel using pneumatic actuator and electric motor. The project focuses on making it possible for a trailer to dump in all the possible directions. The trolley can dump using the pneumatic cylinder provided. The trolley is also equipped with the multi side dumping system. This is achieved using the rotation mechanism. The trolley is fabricated in such a way that it can be dumped and rotated in all the directions using the trolley rotation mechanisms. The rotation can be controlled precisely using a switch and end stoppers. The actuation can be achieved using a pneumatic actuator or a pneumatic cylinder.

III. LITERATURE REVIEW

Before starting with the project work it is very necessary to study the current work carried on the project and understand the scope of this project. So a deep study was made regarding the current work done on this project. A survey carried out by a reputed institute several automobile

garages, put forth the facts that mostly some difficult methods were used in unloading the load from the dumper vessel.

Ganesh Shinde[1] et al studied the „Modern 3 Ways dropping dumper“ which has been conceived by observing the difficulty in unloading the materials. The vehicles can be unloaded from the trailer in three axes without applying an impulsive force. The Direction control valves which activate the ram of the hydraulic cylinder which lifting the trailer cabin in require side

Ganesh Shinde, PrachiTaweale, LaukikRaut developed 3-way dropping dumper. A small scale model has developed using lightweight material i.e. plastic and hydraulically operated piston and cylinder arrangement. This hydraulic system actuated by the motor makes the prototype semi-automatic. Moreover, the battery drives the motor handled using a control panel which is attached with the base model using wires / FRC cable and after that controlled by the operator. A conventional dumper vessel is mounted on a chassis and has an open dump vessel hydraulically operated and hinged at the rear of the dumper by hydraulic cylinders that raise the dumping vessel to unload contents at the desired spot.

IV. CONCEPTUAL DESIGN AND METHOD

As we have adopted Approximation method for drafting out the dimensions of the mechanism were our aim was to build a Pilot model of the precision dumping mechanism were we designed the links and the trailer using solid works designing software as in the figure. As we did trial and error for many dimension in SolidWorks before drafting out the proper dimensions which helped us to know what must be the dimension of the trailer and the stroke of the actuator. And then we finally assembled all the designed components in SolidWorks software.

V. MATERIALS

The mechanism consists of components made of Cast iron. Other materials like MS steel could have been used but cast iron is cheaper and better suited for this pilot project. The target for this mechanism was to portray the conceptual design and not making the actually usable machine, thus we found it wiser to opt for cast iron instead of other costly alternatives.

VI. COMPONENTS

1. Actuator cylinder

Here we are using a pneumatic cylinder of 10 cm stroke length. We went with this stroke length as it was providing a lift that was proportionate with the actual working real-life models. The cylinder can be actuated using compressed air and lifts the dumping vessel whenever required.



Fig 1: Actuator cylinder

2. The chassis

The chassis is made of cast iron which provides good strength and stability to the mechanism. It can absorb the vibration produced by the actuator and works as a foundation for the entire mechanism.

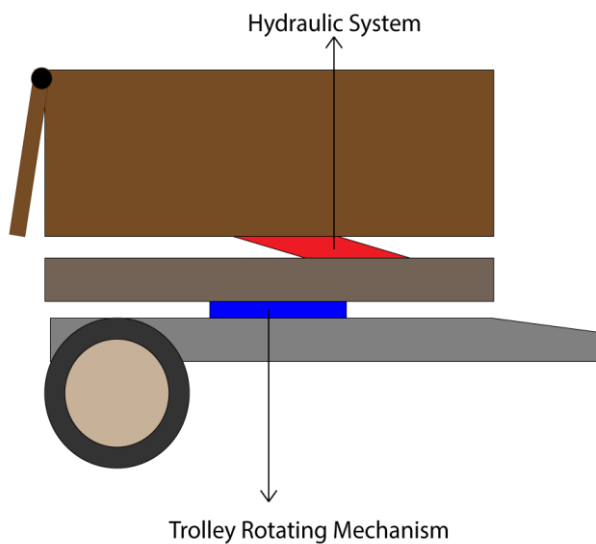


Fig 2: Side view (trailer)

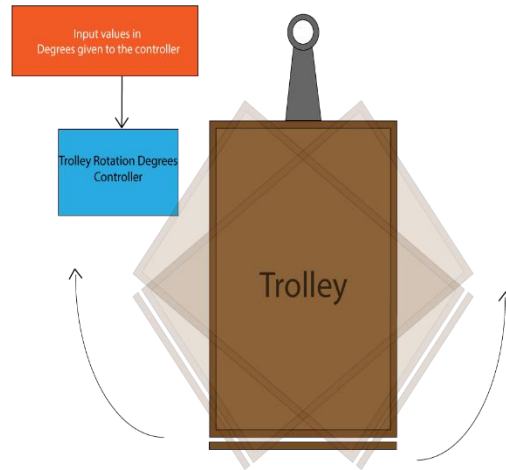


Fig 3: Top view (trailer)

3. Electric D.C. motor

An electric D.C. motor is employed to achieve the rotational movement of the vessel. It's a 400-watt motor that rotates a gear which in turn rotates the vessel using a chain and pinion mechanism.



Fig 4. D.C. motor

4. BATTERY

The battery used here is lithium ion battery which helps us to power the electric motor. The capacity of the battery is of 60 volts.

VIII. CONCLUSION

The mechanism works perfectly fine and assists in the dumping operation. The need for aligning the vehicle with the dumping spot is eliminated and thus dumping of the load becomes convenient and easy. Also, a lot of fuel and time that would otherwise be wasted for manoeuvring the truck is saved.

This mechanism could affect the logistic arms radically and bring a drastic change in the ease with which the work is completed. It would also reduce driver fatigue. Moreover, it would also eliminate the need for a highly skilled driver thus overall facilitating smooth overall dumping operation.

FUTURE SCOPE

For heavy loads and big dumpers, the hydraulic mechanism can be used instead of pneumatic one. Also, more advanced and accurate positioning motor like stepper motor can be used instead of the conventional dc motor for better control.

APPLICATIONS

This model of dumper can be used at construction sites and in urban, densely populated areas to carry out dumping activities. It can also be used at dump yards to dump garbage quickly and conveniently.

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Fig 5: Battery

Compressor

The compressor supplies compressed air to the cylindrical actuator that in turn expands and retracts at the will of the operator with the help of a direction control valve. The compressor powers the tipper mechanism.



Fig 6: compressor

VII. WORKING

The electric motor is operated to rotate the trailer and to bring its rear end to the position where we have to dump the load. This is achieved using a gear pinion and chain mechanism. The operator has the control of the motor and thus can precisely control the movement and the end position of the dumping vessel according to the requirement of the situation.

After aligning the trailer the operator has to actuate the cylindrical actuator using the directional control valve. The compressed air from the compressor helps the piston in the cylinder retract and the trailer is tipped. Thus the load is dumped on the desired location. Then the trailer is brought back to the original position by leaking the air in the piston cylinder to the atmosphere. Also the trailer is rotated and brought back to its original position. Hence the task of dumping the load in a precise manner on the desired spot without manoeuvring the vehicle is completed.