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Review on Three Way Dumping Trolley

Mr. Sachin M.Shinde[1], Mr. Karan N.Dehade[2], Mr. Pravin D.Chavan[3], Mr.Shubham D. Khanzode[4]
Mr. Parmeshwar P.Mhaske[5],Mr.Akash R.tale[6]
Department of MechanicalEngineering[1,2,3,4,5,6,]
Pankaj Laddhad Institute Of Technology, Tq,Buldhana, Dist,Buldhana, Maharashtra,
UG Student [1,,2,3,4,5,6]
Email: shindesachin8956@gmail.com

Abstract- In a hydraulic trolley has lots of use in today's world. In industrial and domestic considerations, trolley can work a variety of products including gravel, agriculture equipment, grain, sand, stone, compost, heavy rocks, etc... In existing system, trolley can unload only in one side by using hydraulic jack. In our project we will use three way trolley mechanisms, which will help the trailer to unload in three directions. We will use pneumatic system and automatic operated solenoid valves for this project. By using this technique it will be easy for the driver to unload the trailer and also it reduces time and fuel consumption. The material is unloaded in three directions and hence can be boldly stated as "Three way directional Dumper." The major outcomes of three ways directional dumper has overcome space requirement which often result in road blocking. Hence, we have invert in this mechanism providing the unloading in 180 rotations. This mechanism prevents blocking of road, reduce time and increase productivity at lowest cost. [1, 4]

Keyword: — Hydraulic Cylinder, Trolley, Chassis, Base, Bearing, Pin, Hydraulic Jack [2]

1. INTRODUCTION

The tipper mechanism it's a great job by unloading the materials in three ways dumping trolley as now day's trolley unloads in only one direction. Existing trailers requires more extra space, time and fuel so to overlook these problems we will be introduce the three way direction tipper mechanism so that the device is economical and efficient. This tipper working generally relates to ball socket joint for unloading the material in left or right side direction and use of hydraulic jack in backing side. The ball socket joint is useful to provide motion in three directions. In this working, the relative motion of ball socket joint and trolley moves in left or right direction. To deliver the material in right side or in left side, we have fixed the one side by hinge joint using pin.

In this paper the hydraulic jack is attached below whole setup to lift the trolley for unloading. This three way mechanism can be applied to both industrial as well as domestic areas. The purpose of this mechanism is safe and efficient and could be used safely in different areas. [3]

A dumper is a vehicle designed for carrying bulk goods, often on building areas or construction side. Dumpers with rubber tracks are using in special circumstances and are popular in some nations. The single one cylinder diesel engine was started by hand cranking. The steering wheel turned the back wheels, not front. Having neither electrics nor hydraulics there was not much to go wrong way. When the catch is released, the skip tips under the weight of its contents at pivot point below, and after being emptied is raised by hand. The dumper is an integral part of any construction working and hence its role is very important for completion of any constructional Areas. [4]

One of the problem are face with dumper in the time and energy for setting the dumper in the proper way to dump the material it in carrying and hence the need of the paper work riser which is about 3 direction way dropping dumper which can unload the material in any direction except the rental one without moving the truck in any direction. Hydraulic cylinders each on front side, right side and left side of trolley to unload loose material on back side, left side and right side of trolley respectively. Some design modification is needed in existing system to work on multisided tipper tilting mechanism. [4]

2. LITERATURE SURVEY

Amboji Sudhakar R. et al studied that Tipper has lots of applications in today‟s world. In industrial and domestic considerations, tippers can haul a variety of products including gravel, potatoes, grain, sand, compost, heavy rocks, etc. By considering wide scope of the topic, it is necessary to do study and research on the topic of tipper mechanism in order to make it more economical and efficient. In existing system, tipper can unload only in one side by using hydraulic jack or conveyor mechanism. By this research it is easy for the driver to unload the trailer and also it reduces time and fuel consumption. For making tipper mechanism with such above conditions both mechanisms namely hydraulic jack and conveyor mechanism can be used. But eventually it comes with question that how both systems can arrange in single set up? Answer to this question is nothing but this research work. [4]

Alley & McLellan of Glasgow studied hydraulics was being incorporated into truck mounted dump bodies relatively early on, in which record shows one of the first hydraulic dump bodies was the Robertson Steam Wagon with a hydraulic hoist that received power from the truck's engine or an independent steam engine was developed another early hydraulic dump body in 1907 that was power-driven by steam [4]

3. HISTROY

3.1.1. Hydraulic Dump Bodies (1920):

Records show that one of the first hydraulic dump bodies was the Robertson Steam Wagon with a hydraulic hoist that received power from the truck's engine or an independent steam engine. Alley & Mclellan of Glasgow developed another early hydraulic dump body in 1907

that was power-driven by steam. Some of the first truck mounted dump bodies that resembled today's bottom dump trucks were being used in the 1920s onward to move coal. The ability of dump trucks to deliver rapid unloading capabilities so more trips could be achieved in a shorter time frame was in great demand' This resulted in the development of a type of dump body called a hopper, similar to a hopper railcar. The dump body was elevated with struts and beams located on the underside in a scissor like pattern. Pulling the beams close together automatically elevated the dump body. Elevating the Dump "body allowed the free flow of material by gravity along chutes and for some distance from the truck. [4]

3.1.2 Crawler Tractor-Trailer (1920):

In the years of the 1920s, crawler tractors pulling heavy dump trailers mounted on wheels were becoming increasingly popular. Sometimes crawlers would pull two to five attached trailers. Companies began developing wagons specifically designed for attachment to crawler tractors [4]

3.1.3 Saint John First (1920):

The Dump truck was first conceived in Saint John, New Brunswick when Robert T.Mawhinney attached a dump box to a flatbed truck in 1920. The lifting device was a winch attached to a cable that fed over sheave (pulley) mounted on a mast behind the cab. The cable was connected to the lower front end of the wooden dump box which was attached by a pivot at the back of the truck frame. The operator turned a crank to raise and lower the box. This invention was instrumental in the development of our present trucking industry. To create this first dump truck, a mast was mounted between the cab of the vehicle and the box. A simple crank handle was used to operate the winch, which raised the front end of the dump box, dumped the load, and then lowered the box. A hydraulic system has since replaced the crank handle, but the basic, concept has remained unchanged. [4]

3.1.4 Euclid Dump Truck (1934):

Euclid was a pioneer in the development of dump trucks. George Armington Jr. son of founder George Arlington was a hydraulics designer and made two significant contributions to the world of dump trucks. These included the modern heavy duty off-highway truck and the wheel tractor bottom wagon. [4]

In 1934 the company introduced its l0/l l-ton dump truck called the “TrakTruk”. It was the first rear-dump truck that was designed for heavy-duty off road service. The truck replaced heavy, gasoline powered chain drive Mack trucks that had previously been used for standard work in construction and mining operations. Another prominent development was the launch of Euclid's wheel tractor bottom dump wagon combination. [4]

3.1.5 Dump Trucks in the (1950):

In the 1940s the technological development of dump trucks had reached its peak. In the U.S., bottom dump trucks were already dominating earthmoving sites by the 1950s. In this situation to need for domestically produced construction site tippers began to emerge... The truck could carry up to 20 tons and was powered with a 180 horsepower engine. The dump trucks were considered "off-highway" dump trucks because of their width and a: de weights. [4]

4. METHODOLOGY

In this model was developed using light weight material i.e. plastic and hydraulically operated piston and cylinder arrangement. This hydraulic arrangement actuates on motor driven which makes the prototype semi-automatic. Moreover, 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 operator. A conventional dump truck is mounted on a truck chassis and has an open dump box hydraulically operated and hinged at the rear of the truck usually by one or more hydraulic rams that raise the dump box to unload contents at a delivery site. These hydraulic rams are either front loaded or mounted in the underbody and are driven from a gear box power take-off. Hydraulic rams mounted in the underbody provide the capability of the dump body to tip the dump box on a three-way basis, either to the left or right side or to the rear. [5]

(A) How a typical tipper trucks works?

The tipping mechanism is the heart of a three way tipper construction truck. Tipping mechanisms works basically as follows:

1) Hydraulics cylinder

In a tipper mechanism there is hydraulic cylinder is placed below the body of truck longitudinally at one end of the truck, and The hydraulic cylinders is connected to piston end by the means of a pivot joint to the chassis of truck. [5]

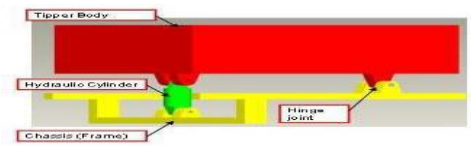

Fig.1.Hydraulic Cylinder Arrangement [5]

2) Three Way Tipper Mechanisms

In a three-way tipper can unload materials in all three sides. To control the sides of tipping one more pneumatic cylinder apart from the main hydraulic cylinder is required. Also we require special types of hinge joints in this case.

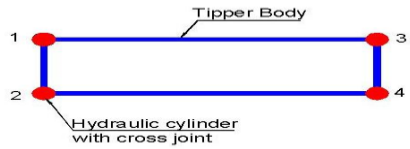

Fig.2Tipper Body [5]

The above diagram shows that a 3-way tipper arrangement showing the main hydraulic cylinders are placed at four corners of the chassis (structure).Each of the four corners of the body is connected by a cross joint with the hydraulic cylinders. The cross joint allows the

joining members to tilt with respect to two perpendicular axis.

Suppose the side of cylinder 3 & 4 is rear of the vehicle, then by operating cylinder no.1 & 2 will cause rear tipping, operating cylinder 2 & 4 will cause left side tipping, and operating cylinder 1 & 3 will cause right side tipping. Automation of tipping will be possible by using a power pack with PLC control or some similar kind of automation device [5]

B. Axles

Single axle dump trucks are the smallest sized dump truck on the market, tandem axle are standard sized, and the tri axle or multi axle dump truck is currently the largest dump truck available that requires a special permit to be operated and is dependent of State/Provincial laws.[5]

C. Hydraulic Pumps

One thing you can see is that the advertised "20000-kg splitting force" is generous. A 4-inch piston has an area of 12.56 square inches. If the pump generates a maximum pressure of 3,000 pounds per square inch (psi), the total pressure available is 37,680 pounds, or about 2,320 pounds shy of 20 tons. [5]

Another way you can determine is the cycle time of the piston. To move a 4-inch-diameter piston 24 inches length, you need 3.14 * 22 * 24 = 301 cubic inches of oil. A gallon of oil is about 231 cubic inches, so you have to pump almost 1.5 gallons of oil to move the piston 24 inches in one direction. That's a fair amount of oil to pump -- think about that the next time you watch how quickly a hydraulic backhoe or skid/loader is able to move! In our log splitter, the maximum flow rate is 11 gallons per minute. That means that it will take 10 or so seconds to draw the piston back after the log is split, and it may take almost 30 seconds to push the piston through a tough log (because the flow rate is lower at high pressures). Just to fill the cylinder with oil, you need at least 1.5 gallons of hydraulic oil in the system. [5]

1) Three Way Tipper Mechanism

Three way tippers can unload materials in all three sides. Also we require special types of hinge joints in this case. It will be having three hydraulic pistons cylinders one on cabin side (as in existing system), one each on lateral sides. Six hinges- 2 on each side to give degree of motion on that side

Fig3. Three way tipper mechanism

The framing will be rigid enough to sustain the reactive forces generated, refer the attached picture of 3-way tipper arrangement. Main hydraulic cylinder is placed at middle of front side of chassis i.e. 1 for back side tilting of the trolley and other two cylinders are placed on along lateral side of the chassis at appropriate distance for left and right side tilting of the trolley. Trolley is connected with chassis with the help of six hinges .Two hinges on each lateral side for left and right side tilting of trolley, two hinges on back side of chassis for back side tilting of trolley. Now with this mechanism it is possible to tilt trolley on all three sides i.e. back, left and right side. For backside dumping of material, hydraulic

Cylinder no. 1 is in operation and hinge must be disconnected manually by pulling pin from the hinge, for this hole. Diameter is provided on pin head to facilitate manual pulling by inserting rope inside the pin hole. [4]

For right side dumping of material hydraulic cylinder is in operation and hinges are to be disconnected manually by pulling pin from the hinge. For this operation cylinder 1 are not in working. The maximum angle made by trolley with horizontal for effective right side unloading of loose material is 200 .Same procedure is adopted for left side dumping of material only change is with hinge disconnection are disconnected and hydraulic cylinder is in operation. Other two cylinders are in not working position. Here also maximum angle of side tilt of trolley is 200 for safely unloading the material [4]

5. ADVANTAGES AND DISADVANTAGES

***Advantages*:**

- Increased moving ability: Thus, it does not become tiresome to perform the Job
- Can be used in very compact places
- Increased complexity.
- Saves time & energy Where the reversing & turning of vehicle is difficult

***Disadvantages*:**

- Cost increases:
- More complications lead to increase in cost.
- Increases of the Maintenance

6. CONCLUSION

In this way we have studied in three way hydraulics dumping trolley mechanisms is the modification of existing conventional dumper mechanism. According to the various extent researched, history and theory of project, this project will help the process of dumping. Hence with the help of this mechanism one can reduce the time of unloading the material in space constraint area. It prevents the blockage of roadways because of its speedy and easy working and it also have the provision of bed movement within 180˚. Bed moves very smoothly with the use of chain drive. Actuator is controlled by D.C.valve and hydraulic pump. So these all equipment helps our dumper to act smoothly, precisely, easily and occur

7. FUTURE SCOPE

In a dumping trolley of the process for an unloading the trailer trolley in left and right direction can be made easier by implementing electric motor system instead of hand lever. Electric motor can be attached underneath the conveyor system and input power can be given to the roller with help of belt and pulley arrangement. Hydraulic jack can be implemented for backside unloading instead of hydraulic cylinder. This implementation will increase the trolley lifting angle up to 45 to 50°. World progressing

at faster rate which demands efficient working equipment such as user friendly machineries and hence the three way dropping dumper may be used more than the two way or one way.[4]

The work can be modified further more on following basis:-

- Dual stage cylinders can be used.
- Oil pump can be used instead of powered cylinder.
- Capacity can be increased.
- Four wheel steering can be adopted for more movement ability [4]

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