3-Way Hydraulic Dumping Trolley

Mr. Abhimanyu D. Deshmukh1 Mr. Vivek R.Pati2 Mr.Vivek S. Chavan3 Mr.Mahesh M. Kadam4 Mr. Dipak M. Bhosale5
1,2,3,4,5 Adharsh Institute of Technology & Research Centre Vita Tal- Khanapur, Dist- Sangli, Maharashtra

Abstract— The oldest dropping dumping has been conceived by observing the difficulty in unloading the sand or assets. there are survey in this regards in automobile garages, revealed the facts that mostly difficult methods were adopted in unloading the materials from the trailer or dumper . This paper has mainly on above difficulty. Hence a prototype of flexible arrangement has been designed. Vehicles can be unloaded from the trailer in three axes without application of any other force. There are way of the mechanism are be control with the help of ball and socket joint which connected to ram of the hydraulic cylinder which lifting the dumper cabin in require side. Further modifications and working limitations will put this work in the main league of use. This research paper is help to saves time & energy which helpful to efficient working. Truck, tipper, dump truck are used to transport loose material from one place to another place at any site in mines or in dump yards to accomplish the actual site requirement. If one can understand the ground condition and availability of space in mines and on construction site, it is very tough task to unload loose material at appropriate place, adjustment of trailer is needed which take considerable time and effort to unload loose material. There was everyone knows that tipper is most useful for unloading loose material on construction site; mines and dump yards. The system available is to unload material on back side. As considering the mines space available is less due to which unloading raw material on left or right side is not possible to take this as a problem Multisided tipper tilting is the need of time. To overcome one side tilting of dumping, multisided tilting mechanism is come into focus. This will help to reduce the efforts to unload loose material one side of tipper.

Key words: Hydraulic Cylinder, Battery, 3way Dumping

I. INTRODUCTION

The tipper mechanism can do a great job by unloading the materials in three way as now day’s trolley unloads in only one direction. Existing trailers requires more extra space, time and fuel so to overcome 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 proposed mechanism used for unloading purpose is safe and efficient and could be used safely in different areas. A dumper is a vehicle designed for carrying bulk goods, often on building areas or construction side. Trolley is distinguished from dump trucks by configuration: a dumper is usually an open Four-wheeled vehicle with the load skip in front of the driver side, while a dump truck has its cab in front of the materials. The skip can tip to dump the load; this is where the name "dumper" comes from. They are normally diesel Fuel powered. The towing eye is fitted for secondary use as a site tractor. Dumpers with rubber tracks are using in special circumstances and are popular in some nations. The early dumpers had a payload of about a ton and were 2- wheel drive, driving on the front axle and steered at the back side wheels. 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 Ares. 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.

II. LITERATURE SURVEY

Ganesh Shinde et al studied the „Modern 3 Ways dropping dumper which has been conceived by observing the difficulty in unloading the materials. The survey in this regards in several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer. They have mainly focused on above difficulty. Hence a prototype of suitable arrangement has been designed. The vehicles can be unloaded from the trailer in three axes without application of any impact force. The Direction control valve which activates the ram of the hydraulic cylinder which lifting the trailer cabin in require side. Further modifications and working limitations will put this work in the main league of use. This concept saves time & energy which leads to efficient working.

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.

Alley & McLellan of Glasgow studied hydraulics
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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
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III. HISTORY

A. Hydraulic Dump Bodies

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or an independent steam engine. Alley & McLellan of
Glasgow developed another early hydraulic dump body in
1907 that was power-driven by steam. Hydraulics was being
incorporated into truck mounted dump bodies.

B. Types of Dump Truck

1) Standard Dump Truck

Another kind of 8x4 dump truck: three rear axles (two
powered one lift). A standard dump truck is a truck chassis
with a dump body mounted to the frame. The bed is raised by
a hydraulic ram mounted under the front of the dumper body
between the frames, and the back of the bed is hinged at the
back to the truck. The tailgate can be configured to swing on
hinges or it can be configured in the “High Lift Tailgate”
format wherein pneumatic rams lift the gate open and up
above the dump body.

2) Articulated Dump Truck

An articulated dump truck, or “Yuke” in the construction
world, has a hinge between the cab and the dump box, but is
distinct from semi-trailer trucks in that the cab is a permanent
fixture, not a separable vehicle. Steering is accomplished via
hydraulic rams that pivot the entire cab, other than rack and
pinion steering on the front axle. This vehicle is highly
adaptable to rough terrain. In line with its use in rough terrain,
longer distances and overly flat surfaces tend to cause
driveline troubles, and failures. Articulated trucks are often
referred to as the modern scraper, in the sense that they carry
a much higher maintenance burden than most trucks. See
the first mass produced articulated dump truck (articulated
hauler).

3) Transfer Dump Truck

A transfer dump is a standard dump truck which pulls a
separate trailer which can also be loaded with aggregate
(gravel, sand, asphalt, klinkers, snow, wood chips, triple mix,
etc.). The second aggregate container, (B box) on the trailer,
is powered by either an electric, pneumatic motor or
hydraulic line. It rolls on small wheels, riding on rails from the
truck's frame, into the empty main dump (A) box. This
maximizes payload capacity without sacrificing the
maneuverability of the standard dump truck. Transfer dumps
are typically seen in the western United States because of the
peculiar weight restrictions on western highways. Another
configuration is called a Triple Transfer Train, which consists
of a B and C box. These are common on Nevada and Utah
Highways but not in California. Depending on the axle
arrangement, a Triple Transfer can haul up to 129,000
kilograms (280,000 pounds) with a special permit in certain
US states. The Triple Transfer usually costs a contractor
about $105 an hour while A/B configures usually runs about
$85 per hour (2007 stats).

C. Traditional Tipper Trailer

1) Single Trolley Trailer

These type of trailers can unload goods in only back side
direction, for this type of unloading either hydraulic or
conveyor system is used. Trailers with conveyor system are
quite effective than trailers with hydraulic jack but these both
systems can unload the goods in only back side direction,
therefore more space and time required.

2) Double Trolley Trailer

These types of trailers are used to carry more goods at single
time. To unload two trolleys skilled driver is required also it
requires more space, time and thereby fuel requirement
increases.

IV. NEED OF PAPER

This idea was came from the visited a constructional site few
days ago. There we found that a dumper was unloading loose
material such as sand, gravel, and dirt. A dumper is an integral
part of any construction work and hence its role is important
for completion of work on site. Typical dumper trucks can
generally unload material only exactly of its back side. One
thing was remarkable that on complicated locations such as
on angular sides and directional sides (left and right) of
dumper the unloading of material became quite difficult. In
such conditions dumper truck remained ideal. It consumed
extra. Dumpers are also the most common cause of accidents
involving construction site and plant also. A typical dump
truck is equipped with a pneumatically operated open box
dead hinged at rear. The front of which can be lifted up to
allow the contents to be deposited on the ground behind the
truck at side of delivery. Nowadays dumpers with swivel
skips could be rotated to sideways (3 directional dumper)
which become popular, especially for working in narrow sites
such as road works. But still this technology is insufficient for
fulfilling our requirement for complete unload. This
technology concerns only on solving the problem of
unloading on directional sides of dumper. One of the
problems is cited with dumper in the time & energy for
operating the huge dumper in the proper direction to dump
the material carrying in it hence the need of paper work riser
was is about Multidirectional dropping dumpers which dump
the material in any direction with moving trolley in any
direction. With rise of chances in technology, it is become
essential to find a viable alternative to 3 way dumper system.

V. METHODOLOGY

A small scale model has 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.

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) Hydraulic Cylinder
A hydraulic cylinder is placed below the body of truck longitudinally at one end of the truck, and the piston end of the hydraulic cylinders is connected by the means of a pivot joint to the chassis of truck.

![Hydraulic Cylinder Arrangement](image1)

**Fig. 1: Hydraulic Cylinder Arrangement**
In the forward stroke of the cylinder, it pushes the truck body upward thus gives necessary lift for tipping dumping. So, in the forward stroke of the cylinder, the truck is unloaded. In the return stroke of the cylinder the body of the truck comes to its original position.

B. Hinge Joint
The other bottom end of the body of the truck is connected by a hinged joint with the chassis.

![Unloading Position](image2)

**Fig. 2: Unloading Position**

3-way tipper can overcome this problem, as it can unload material on three sides.

C. Three Way Tipper Mechanisms
As already mentioned, 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.

![Tipper Body](image3)

**Fig. 3: Tipper Body**
The diagram of 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 devices

D. 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.

E. 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.

Another thing 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.

F. Tipping Mechanism

1) Hydraulic Cylinder
A hydraulic cylinder is placed below the body of truck longitudinally at one end of the truck; the piston end of the hydraulic cylinder is connected by the means of a pivot joint to the trolley of truck as well as with the chassis. In the forward stroke of the cylinder it pushes the truck body and operat cylinder 1 & 3 will cause right side tipping.

2) Tipper Body
As already mentioned, 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.
driveline components are reviewed. The material properties of driveline components are referred from design data handbooks, material handbooks. The failure theories for different load condition are considered in analyzing the driveline components. The ultimate strengths that are exhibited by the materials are taken into consideration to predict about the failure criteria.

a) How Typical Tipper Trucks Works

The tipping mechanism is the heart of a three way tipper construction truck. Tipping mechanism works basically on the followings:

- Hydraulic cylinder: A hydraulic cylinder is placed below the body of truck longitudinally at one end of the truck; the piston end of the hydraulic cylinder is connected by the means of a pivot joint to the chassis of truck as well as with the chassis. In the forward stroke of the cylinder it pushes the truck body upward thus gives necessary lift for tipping.

![Fig. 4: Three way tipper mechanism](image)

2) Three way tipper mechanism

Three way tipppers can unload materials in all three sides. Also we require special types of hinge joints in this case. It will be having three hydraulic piston 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. 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.

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.

VI. ADVANTAGES & DISADVANTAGES

- Increased moving ability: Thus, it does not become tiresome to perform the job.
- Can be used in very compact places:
- Where reversing & turning of vehicle is difficult.
- Accommodate on dam site working.
- Saves time & energy.
- Increased complexity:
- It requires complex mechanism for getting desired output.
- Cost increases:
  1) More complications lead to increase in cost.
  2) Increase in Maintenance.

VII. CONCLUSION

Till now we were using the trolley with single way dumping mechanism. After literature survey it is found that the traditional method used in trolley consumes a lot of time as well as energy. It also requires trained personnel for activating the mechanism. So these problems present in traditional method could be overcome by proposed mechanism. After few modifications, and working on disadvantages will put this paper work in the main league of use. This concept saves time and may lead to efficient working. The constructional work or the infrastructural work demands efficient and user friendly machineries which may lead to more and more use of the present paper work. Design of multisided tipper tilting mechanism is done to help unloading loose material on three side of the tipper as per the availability of space. The design is safe for the maximum load of 16 MT which is rigid enough to transport loose material from one site to another site. Design of hinge is the most important part for side tilting of the trolley. Selection of material is also important factor for design of pin, EN8 material is selected which is having tempered and hardened capacity which is reducing the size of pin for the narrow work space and insufficient loading access restricted the parking position of the tipper.

VIII. FUTURE SCOPE

The process of 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.

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.

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