

An Approach Towards Uni-Directional Dumper

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ABSTRACT

The Modern unidirectional dumper 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. This paper has mainly focused on above difficulty. Hence a prototype of suitable arrangement has been designed. The vehicles can be unloaded from the trailer in 1800 without application of any impact force. The Direction control valves which activate 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. Conventional tipper mechanism an unload materials only at the backside of the tipper using hydraulically operated cylinder which may cause the problems of road blockage in the limited space area. 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.

Keywords: Computer Aided Modeling, Dumper, Hydraulic Jack, Conveyor Mechanism etc.

ARTICLE INFO

Article History

Received : 29th February 2016

Received in revised form :

1st March 2016

Accepted : 4th March 2016

Published online :

6th March 2016

I. INTRODUCTION

Material handling in construction and civil works is one of the basic necessities. The material supply to civil and construction is provided through trucks, dumper etc. The material should be properly loaded, managed, stacked, transported and unloaded. The dumper carries the material which is loaded from the site, where the material is initially stored. It is then loaded to the dumper and transported to the required site and then unloaded. The major issues raises over here, the incompatibility of the site with the fully loaded dumper causes a lot of settling time for the trolley to get the material properly arranged and transportation time to reach its location. The dumper unloads the material in only one direction. But this incapability can be fulfilled by a new method mechanism as the unidirectional dumper. This proposed mechanism is an approach to reduce the idle time to settle the dumper. The material is unloaded in any

direction and hence can be boldly stated as "UNIDIRECTIONAL DUMPER."

A dumper whose material can easily be unloaded in one direction that is mostly to its rear end. These inefficiency is been overcomes by the unidirectional dumper

The major outcomes of unidirectional dumper has overcome space requirement which often result in road blocking. Hence, we have inversion in the existing mechanism providing the unloading in lateral six directions. This mechanism prevents blocking of road, saves time and enhances productivity. The advancement while following the protocol of this unidirectional dumper can be done by additional enhancement by using wireless motion control, auto balancing, auto guided vehicle system, auto weighing arrangement.

II. COMPONENTS OF UNI-DIRECTIONAL DUMPER

The proposed Unidirectional Dumper is assembly of the following components.

- A. Air Compressor
- B. Solenoid Valve
- C. Worm and Worm Gear
- D. Electric Motor
- E. Pneumatic Cylinder
- F. DPDT switch
- G. Ball Bearing

A. Air Compressor -

An air compressor is a device that converts power (usually from an electric motor, a diesel engine or a gasoline engine) into potential energy by forcing air into a smaller volume and thus increasing its pressure. The energy in the compressed air can be stored while the air remains pressurized. The energy can be used for a variety of applications, usually by utilizing the kinetic energy of the air as it is depressurized. There are numerous methods of air compression, divided into either positive-displacement or negative-displacement types.



Fig.1: Air Compressor

TABLE I
COMPRESSOR SPECIFICATION

S.N	Type	Specification
1	Compressor Type	Reciprocating Compressors
2	Maximum Pressure	150 PSI
3	High Flow Rate	35 L/min
4	Power Input	12V DC 15A
5	Pressure Gauge	Metal

B. Solenoid Valve -

It is an electromechanically operated valve. Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

They are widely used in the hydraulics industry. These valves make use of electromechanical solenoids for sliding of the spool. Because simple application of electrical power provides control, these valves are used extensively. However, electrical solenoids cannot generate large forces unless supplied with large amounts of electrical power.

Heat generation poses a threat to extended use of these valves when energized over time. Many have a limited duty cycle. This makes their direct acting use commonly limited to low actuating forces. Often a low power solenoid valve is used to operate a small hydraulic valve (called the pilot) that starts a flow of fluid that drives a larger hydraulic valve that requires more force.

A bi-stable pneumatic valve is typically a pilot valve that is a 3 ported 2 position detented valve. The valve retains its position during loss of power, hence the bi-stable name.

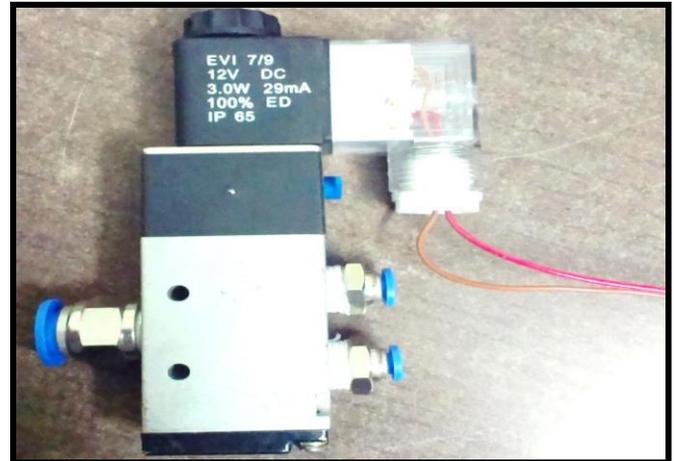


Fig.2: Solenoid Valve

C. Worm and Worm Gear -

Worm gears resemble screws. A worm gear is usually meshed with a spur gear or a helical gear, which is called the gear, wheel, or worm wheel. Worm-and-gear sets are a simple and compact way to achieve a high torque, low speed gear ratio. For example, helical gears are normally limited to gear ratios of less than 10:1 while worm-and-gear sets vary from 10:1 to 500:1 a disadvantage is the potential for considerable sliding action, leading to low efficiency.

A worm gear is a species of helical gear, but its helix angle is usually somewhat large (close to 90 degrees) and its body is usually fairly long in the axial direction. These attributes give it screw like qualities. The distinction between a worm and a helical gear is that least one tooth persists for a full rotation around the helix. If this occurs, it is a 'worm'; if not, it is a 'helical gear'. A worm may have as few as one tooth. If that tooth persists for several turns around the helix, the worm appears, superficially, to have more than one tooth, but what one in fact sees is the same tooth reappearing at intervals along the length of the worm. The usual screw nomenclature applies, a one-toothed worm is called single thread or single start, a worm with more than one tooth is called multiple threads or multiple starts. The helix angle of a worm is not usually specified. Instead, the lead angle, which is equal to 90 degrees minus the helix angle, is given. In a worm-and-gear set, the worm can always drive the gear. However, if the gear attempts to drive the worm, it may or may not succeed. Particularly if the lead angle is small, the gear's teeth may simply lock against the worm's teeth, because the force component circumferential to the worm is not sufficient to overcome friction.

If the gear in a worm-and-gear set is an ordinary helical gear only a single point of contact is achieved. If medium to high power transmission is desired, the tooth shape of the gear is modified to achieve more intimate contact by making both gears partially envelop each other. This is done by making

both concave and joining them at a saddle point; this is called a cone-drive. Or "Double enveloping"
Worm gears can be right or left-handed, following the long-established practice for screw threads.



Fig.3: Worm and Worm Gear

D. Electric Motor -

It is an electrical machine that converts electrical energy into mechanical energy. The reverse of this would be the conversion of mechanical energy into electrical energy and is done by an electric generator.

In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy.

Found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives, electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating sources, such as from the power grid, inverters or generators. Small motors may be found in electric watches. General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use.

The largest of electric motors are used for ship propulsion, pipeline compression and pumped-storage applications with ratings reaching 100 megawatts. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on.

Electric motors are used to produce linear or rotary force (torque), and should be distinguished from devices such as magnetic solenoids and loudspeakers that convert electricity into motion but do not generate usable mechanical powers, which are respectively referred to as actuators and transducers.



Fig.4: Speed reduction assembly of Electric Motor

E. Pneumatic Cylinder -

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage.

Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics is used to prevent fluid from dripping onto people below the puppets.



Fig.5: Pneumatic Cylinder

F. DPDT switch -

The most familiar form of switch is a manually operated electromechanical device with one or more sets of electrical contacts, which are connected to external circuits. Each set of contacts can be in one of two states: either "closed" meaning the contacts are touching and electricity can flow between them, or "open", meaning the contacts are separated and the switch is no conducting.

In electronics, switches are classified according to the arrangement of their contacts. A pair of contacts is said to be "closed" when current can flow from one to the other. When the contacts are separated by an insulating air gap, they are said to be "open", and no current can flow between them at normal voltages. The terms "make" for closure of contacts and "break" for opening of contacts are also widely used.

The terms pole and throw are also used to describe switch contact variations. The number of "poles" is the number of separate circuits which are controlled by a single switch. For example, a "2-pole" switch has two separate identical sets of contacts controlled by the same switch. The number of "throws" is the number of separate wiring path choices other than "open" that the switch can adopt for each pole. A single-throw switch has one pair of contacts that can either be closed or open. A double-throw switch has a contact that can be connected to either of two other contacts; a triple-throw has a contact which can be connected to one of three other contacts, etc.



Fig.6: DPDT switch

G. Ball Bearing -

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Ball bearings tend to have lower load capacity for their size than other kinds of rolling-element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.



Fig.7: Ball Bearing

III. CAD MODEL OF UNI-DIRECTIONAL DUMPER

Modelling is the process of producing a model; a model is a representation of the construction and working of some system of interest. A model is similar to but simpler than the system it represents. One purpose of a model is to enable the analyst to predict the effect of changes to the system. On the one hand, a model should be a close approximation to the real system and incorporate most of its salient features. On the other hand, it should not be so complex that it is

impossible to understand and experiment with it. A good model is a judicious tradeoff between realism and simplicity. Simulation practitioners recommend increasing the complexity of a model iteratively. An important issue in modelling is model validity. Model validation techniques include simulating the model under known input conditions and comparing model output with system output.

In this project, we used the AutoCAD and Pro-E software for the purpose of drafting and modelling of Unidirectional Dumper. AutoCAD (a product and registered trademark of Autodesk Inc., USA) is low cost yet very effective computer aided design and drafting software. AutoCAD is accepted as the industry standard and it is preferred by large community of CAD users in the world. AutoCAD supports 2D drafting and 3D modelling.

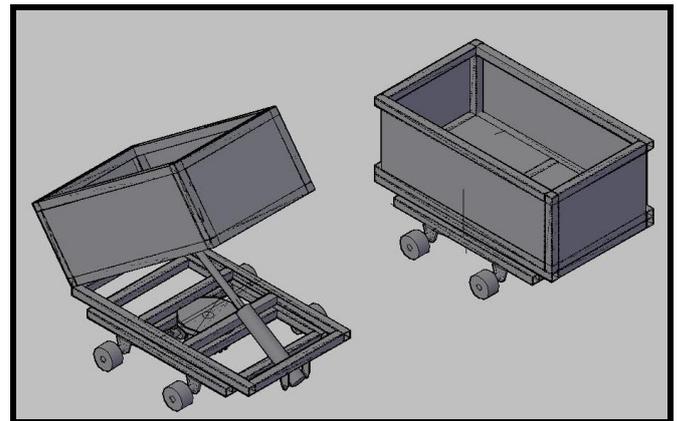


Fig.8: CAD model of Uni-Direction Dumper

IV. PROPOSED ASSEMBLY OF UNI-DIRECTION DUMPER

The prototype of unidirectional dumper is thoroughly based on pneumatic system for light weight load and for heavy weight load hydraulic system is suitable. This prototype model consists of Air compressor, air reservoir, Pressure gauge, 5/3 solenoid valve, pneumatic cylinder, DPDT (Double pole double throw), etc. An operating system consists of electric motor, worm & worm gear mechanism to rotate the dumper horizontally in required direction. Two Chassis (Frame) is provided on which trolley is mounted, where first frame of chassis is stationary & attached to the worm & worm gear to rotate the trolley horizontally in required direction. Second frame of chassis consists, one end of Pneumatic cylinder which is hinged with this frame of chassis and other end of pneumatic cylinder is also hinged but to the one end of trolley to give vertical movement. Model has constructed using various material like MDF (Medium density fibre core) hard wood plywood, 3/16 nuts & bolts, aluminium sheet, motors (DC), gearboxes, syringes, wheel screw, nuts, toggle switches, push buttons, battery etc. Firstly, a base chassis structure is prepared using MDF 8mm sheet. This structure incorporates driving motor along with steering motor. These motors are fixed with a fixed reduction ratio gearbox of 100:1 to increase torque and reduce speed of the motor. The wheel base is kept 14" while the track distance to the output slate of the gearbox which is associated with the DC motor and gearbox assembly is fixed in the wheel hub, and it is attached with the chassis using aluminium sheet. A steering rod connects both the wheels of truck with a steering motor.

V. CONCLUSION

Uni-Directional Dumper can be efficiently used in very compact places where turning of vehicle is difficult. This may reduce the amount of accidents on constructional site or plant. Dumper may increase moving ability as it does not become tiresome to perform the job. Further labour cost will be decrease.

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