# UNIVERSAL TRAILER MECHANISM

Mr. Gaurang Prajapati

[1] *Lecturer, Mechanical Engineering Department, SB Polytechnic, Savli, Gujarat, India*

**ABSTRACT**

*This project work titled "Universal trailer mechanism" using screw spindle and roller bearing has been conceived having studied the difficulty in unloading the materials. Our survey in the regard in several automobiles garages, revealed the fact the mostly some difficult methods were adopted in unloading the materials from the trailer. The trailer will unload the material in only one single direction. It is difficult to unload the materials in small roads. In our project these are rectified to unload the trailer in all three sides very easily. Now the project has mainly concentrated on this difficulty, and hence a suitable arrangement has been designed. Such that the vehicles can be unloaded from the trailer in three axis without application of any impact force. By actuating the direction control valve, the hydraulic oil goes to the hydraulic cylinder through valve. The ram of the hydraulic cylinder acts as a lifting the trailer cabin.*

**Keyword** - *Universal trailer mechanism, Spur pinion gear, Tapper rolling bearing, Screw spindle mechanism etc….*

## 1. INTRODUCTION

A trailer is a vehicle designed for carrying bulk material, often on building sites. Trailers are distinguished from dump trucks by configuration: a trailer is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a dump truck has its cab in front of the load. The skip can tip to dump the load; this is where the name "trailer" comes from. A trailer is an integral part of any construction work and hence its role is important for completion of any constructional site. One of the problem are cited with trailer in the time and energy for setting the huge trailer in the proper direction to dump the material it in carrying and hence the need of the project work riser which is about 3 way dropping trailer which can dump the material in any direction except the rental one without moving the truck in any direction. A trailer is generally an unpowered vehicle towed by a powered vehicle. It is commonly used for the transport of goods and materials.

Sometimes recreational vehicles, travel trailers, or mobile homes with limited living facilities, where people can camp or stay have been referred to as trailers. In earlier days, many such vehicles were towable trailers.

This project work titled "The universal Trailer mechanism" has been conceived having studied the difficulty in unloading the materials. Our survey in the regard in several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer. The trailer will unload the material in only one single direction. It is difficult to unload the materials in small compact streets and small roads. In our project these are rectified to unload the trailer in all three sides very easily. Now the project has mainly concentrated on this difficulty, and hence a suitable arrangement has been designed. Such that the vehicles can be unloaded from the trailer in three axes without application of any impact force. By actuating the Direction control valve, the hydraulic oil goes to the hydraulic cylinder through valve. The ram of the hydraulic cylinder acts as a lifting the trailer cabin.

## 2. Working principle of universal trailer mechanism.

This project work titled "The universal Trailer mechanism" has been conceived having studied the difficulty in unloading the materials. Our survey in the regard in several automobile garages, revealed the facts that mostly some difficult methods were adopted in unloading the materials from the trailer. The trailer will unload the material in only one single direction. It is difficult to unload the materials in small compact streets and small roads. In our project these are rectified to unload the trailer in all three sides very easily. Now the project has mainly concentrated on this difficulty, and hence a suitable arrangement has been designed. Such that the vehicles can be unloaded from the trailer in three axes without application of any impact force. By actuating the Direction control valve, the hydraulic oil goes to the hydraulic cylinder through valve. The ram of the hydraulic cylinder acts as a lifting the trailer cabin. This hydraulic oil is controlled by the directional control valve. The setup consists of three hydraulic cylinders, dc motor, three directional control valves and a tray for lifting purpose. The movable tray consists of hydraulic cylinder and directional control valve for control purpose. When the motor is switched on the hydraulic oil flows over the tube to the hydraulic cylinder. Now the piston of the hydraulic cylinder is ready to lift the tray with the help of the hydraulic oil. This lifting of up and down movements is controlled by the directional control valves. For lifting in three different directions three separate hydraulic cylinders and directional controls are used. The forward and reverse movement of the directional control valve tends to lift the hydraulic cylinder piston up and down. The hydraulic cylinder is controlled by DCV and is used to lift the tray in three directions. Lock is done manually using clamp locker. Trailer system is widely used for material transportation in big construction projects. Due to its load carrying capacity and material handling facilities, trailers are being used as popular load carriers. In most cases where road width is not sufficient, trailers face the problems while unloading the material. It takes a lot of time to unload a single trolley as all material cannot be unloaded at same place. Hence additional time is required for turning of vehicle in highly congested area. Also in case of large trolleys, if all the material is unloaded at one place additional manpower is required to arrange the material properly which finally increases material handling cost. At the same time, the trailers unload the material backside i.e. in one axis only. Modern Three Axis Hydraulic Trailer incorporates the Hydraulic cylinder. It is used to lift the load with help of Hydraulic cylinder. The main purpose of this project is to unload the material in three directions instead of conventional trailer system in which the unloading is done in one direction. This system is very much useful in constructional sites having low turning space, to reduce the additional labor cost.

In this trailer we using spindle screw mechanism and roller bearing its connects with trailer base. Trailer base connects with motor when motor is rotate when time roller bearing is rotating. Roller bearing is connect to spur and pinion gear. Trailer base is moving in three directional and rotating in 180 degree on base.

### 2.1 Load calculations

The torque required to lift or lower a load can be calculated by "unwrapping" one revolution of a thread. This is most easily described for a square or buttress thread as the thread angle is 0 and has no bearing on the calculations.

The unwrapped thread forms a right angle triangle where the base is {\displaystyle \pi d_{m}} long and the height is the lead (pictured to the right). The force of the load is directed downward, the normal force is perpendicular to the hypotenuse of the triangle, the frictional force is directed in the opposite direction of the

direction of motion (perpendicular to the normal force or along the hypotenuse), and an imaginary "effort" force is acting horizontally in the direction opposite the direction of the frictional force. Using this free-body diagram the torque required to lift or lower a load can be calculated.

| Screw material | Nut material | | | |
|---|---|---|---|---|
| | Steel | Bronze | Brass | Cast iron |
| Steel, dry | 0.15–0.25 | 0.15–0.23 | 0.15–0.19 | 0.15–0.25 |
| Steel, machine oil | 0.11–0.17 | 0.10–0.16 | 0.10–0.15 | 0.11–0.17 |
| Bronze | 0.08–0.12 | 0.04–0.06 | - | 0.06–0.09 |

where

T = torque μ = coefficient of friction (common values are found in the adjacent table)
F = load on the screw dm = mean diameter l = lead Ø = angle of friction

Based on the T equation it can be found that the screw is self-locking when the coefficient of friction is greater than the tangent of the lead angle. An equivalent comparison is when the friction angle is greater than the lead angle. {\displaystyle \phi >\lambda } When this is not true the screw will back-drive, or lower under the weight of the load. The efficiency, calculated using the torque equations above, is:

For screws that have a thread angle other than zero, such as a trapezoidal thread, this must be compensated as it increases the frictional forces. The equations below take this into account:
is one half the thread angle. If the leadscrew has a collar in which the load rides on then the frictional forces between the interface must be accounted for in the torque calculations as well. For the following equation the load is assumed to be concentrated at the mean collar diameter (dc):
is the coefficient of friction between the collar on the load and dc is the mean collar diameter. For collars that use thrust bearings the frictional loss is negligible and the above equation can be ignored.
Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work Introduction related your research work .

Coefficient of friction for thrust collars

| Material combination | Starting | Running |
|---|---|---|
| Soft steel / cast iron | 0.17 | 0.12 |
| Hardened steel / cast iron | 0.15 | 0.09 |
| Soft steel / bronze | 0.10 | 0.08 |
| Hardened steel / bronze | 0.08 | 0.06 |

Safe running speeds for various nut materials and loads on a steel screw

| Nut material | Safe loads [psi] | Speed |
|---|---|---|
| Bronze | 2500–3500 | Low speed |
| Bronze | 1600–2500 | 10 fpm |
| Cast iron | 1800–2500 | 8 fpm |
| Bronze | 800–1400 | 20–40 fpm |
| Cast iron | 600–1000 | 20–40 fpm |
| Bronze | 150–240 | 50 fpm |

where

N = critical speed in RPM
L = length between bearing supports in inches
C = 1.00 for both ends simple
C = 2.23 for both ends fixed
$d_r$ = smallest (root) diameter of the lead screw in inches
C = .36 for one end fixed, one end free
C = 1.47 for one end fixed, one end simple

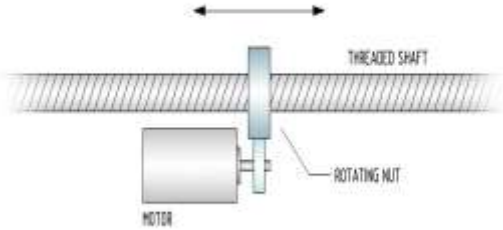
**2.2 Main parts of universal trailer mechanism**

Spur pinion gear
Screw spindle mechanism
Hydraulic cylinder
Taper roller bearing
Induction motor
Knuckle joint

**spur pinion gear**

**Taper roller bearing**

**Screw spindle mechanism**




**2.3 Induction motor**

An induction motor or 3 phase induction motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor's rotor can be either wound type or squirrel-cage type.

Three-phase squirrel-cage induction motors are widely used in industrial drives because they are rugged, reliable and economical. Single-phase induction motors are used extensively for smaller loads, such as household appliances like fans. Although traditionally used in fixed-speed service, induction motors are increasingly being used with variable-frequency drives (VFDs) in variable-speed service. VFDs offer especially important energy savings opportunities for existing and prospective induction motors in variable-torque centrifugal fan, pump and compressor load applications. Squirrel cage induction motors are very widely used in both fixed-speed and variable-frequency drive (VFD) applications.

## 3. Knuckle joint

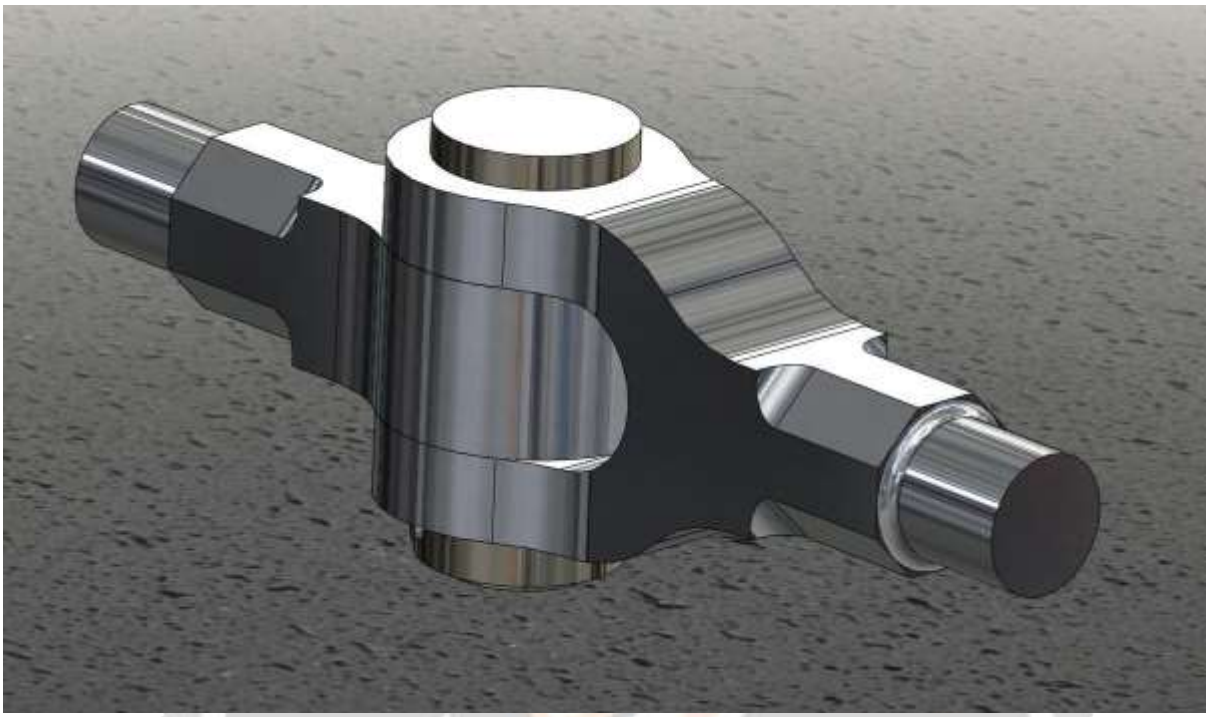
Knuckle joint is a type of mechanical joint used in structures, to connect two intersecting cylindrical rods, whose axes lie on the same plane. It permits some angular movement between the cylindrical rods (in their plane). It is specially designed to withstand tensile loads.

A mechanical joint is a section of a machine which is used to connect one mechanical part to another. Mechanical joints may be temporary or permanent, most types are designed to be disassembled. Most mechanical joints are designed to allow relative movement of these mechanical parts of the machine in one degree of freedom (insert LINK), and restrict movement one or more others. Mechanical joints are much cheaper and are usually bought ready assembled.

A knuckle joint is used to connect the two rods which are under the tensile load, when there is requirement of small amount of flexibility or angular moment is necessary. There is always axial or linear line of action of load.

The knuckle joint assembly consist of following major components

1. Single eye. 2. Double eye or fork 3.Knuckle pin.



**3.1 The modes of failure are:**
1.Shear failure of pin (single shear).
2.Crushing of pin against rod.
3.Tensile failure of flat end bar.

**3.2 Design of knuckle joint**

The assembly diagram of knuckle joint is as shown in fig.
The dimension of knuckle joints are
Diameter of rod = d
Diameter of knuckle pin = dp
Outside diameter of single eye = doe
Outside diameter of double eye = dod
Thickness of single eye = t
Thickness of fork = t1
Axial tensile force on rod = P

**3.3 Applications of Knuckle Joint:**

Knuckle joints find a wide variety of applications. They are used in:

Bicycle chains
Tractors
Trusses
Automobile wipers
Chain straps of watches
Cranes
Structural members
Robotic joints
Earth movers

## 4. Future modification

As the world progressing at faster rate we meet mover and mover huge construction which head to be dig big and big amount of the earth and thus more efficiently working equipment are to be required and hence the Development of a universal trailer mechanism may be used more than the two way or one way. India is progressing at higher rate and hence infrastructural development is on its high. Hence the future of this project work seems promising.
The project 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.
- Wheel steering can be adopted for avoiding the lifting of vehicle along with trailers.

## Conclusion

The developed prototype exhibits the expected results. 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. This further line should be modeled using equations and an experimental agreement. The constructional work or the infrastructural work demands efficient and user friendly machinery which will lead to more and more use of three way dropping trailer.

## References

R.K.Bansal, Pascal, A Text Book of Fluid Mechanics and Machinery, Laxmi Publications, New Delhi, 2000.
R.S. Khurmi, J.K. Gupta, 14th Edition. Machine Design, S. Chand & Company Ltd., New Delhi, 2000.
R.S. Khurmi, J.K. Gupta, Theory of machines, S. Chand & Company Ltd., New Delhi, 2008.
www.tractorbynet.com.