



THREE AXES TRAILER WITH SINGLE PNEUMATIC CYLINDER USING GEAR MECHANISM

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Abstract: This project work titled “THREE AXES TRAILER WITH SINGLE PNEUMATIC CYLINDER USING GEAR MECHANISM” has been conceived having studied the difficulty in unloading the materials. This survey in the regard in several automobile garages, several shop floors 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 this project these are rectified to unload the trailer in all three sides very easily using gear mechanism

Keyword: Pneumatic cylinder, Trailer, Spur Gear, Automation, Rotating plate.

1. Introduction

A trailer is a vehicle designed for carrying bulk equipment, 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. They are normally diesel powered. A towing eye is fitted for secondary use as a site tractor. Trailers with rubber tracks are used in special circumstances and are popular in some countries. Early trailers had a payload of about a ton and were 2-wheel drive, driving on the front axle and steered on the back wheel. The single cylinder diesel engine (sometimes made by Lister) was started by hand cranking. The steering wheel turned the back the wheel, not the front. It is easy for the driver to unload the trailer in three sides and also it reduces time and fuel consumption [4]. Having neither electrics nor hydraulics, there was not much to go wrong. Pneumatic systems use pressurized gas, mostly air, to transmit motion and power [7]. The skip was secured by a catch by the driver's feet. When the catch is released, the skip tips under the weight of its contents at pivot points below, and after being emptied, is raised by hand. Modern trailers have payloads of up to 10 tonnes (11 short tons; 9.8 long tons) and usually steer by articulating at the middle of the chassis (pivot steering). Choosing this project for the decreasing the man power and time [2]. They have multi-cylinder diesel engines, some turbocharged, electric start and hydraulcs for tipping and steering and are more expensive to make and operate. An A-frame known as a ROPS (Roll-Over Protection) frame may be fitted over the seat to protect the driver if the trailer rolls over. Some trailers have FOPS (Falling Object Protection) as well. Lifting skips are available for discharging above ground level. In the 1990s trailers with swivel skips, which could be rotated to tip sideways, became popular, especially for working in narrow sites such as road works. Trailers are the most common cause of accidents involving construction plants. A trailer is an integral part of any construction work and hence its role is important for completion of any construction site.

The word 'pneuma' comes from Greek and means wind. The word pneumatics is the study of air movement and its phenomena is derived from the word pneuma. Today pneumatics is mainly understood to mean the application of air as a working medium in industry especially the driving and controlling of machines and equipment. Pneumatics has for some considerable time been used for carrying out the simplest mechanical tasks in more recent times has played a more important role in the development of pneumatic technology for automation. Pneumatic systems operate on a supply of compressed air which must be made available in sufficient quantity and at a pressure to suit the capacity of the system. When the pneumatic system is being adopted for the first time, however it will indeed be necessary to deal with the question of compressed air supply.

2. Objective

- Study different mechanism and develop various types of mechanism to achieve the desired motion.
- Analysis of developed mechanisms in Solid works and make comparisons between them.
- To reduce man power
- To increase the efficiency of the vehicle
- To reduce the work load
- To reduce the fatigue of workers
- To high responsibility
- Less Maintenance cost

3. Calculation and Specification

3.1 Design of Ball Bearing

Bearing No. 6202

Outer Diameter of Bearing (D)	=	35 mm
Thickness of Bearing (B)	=	12 mm
Inner Diameter of the Bearing (d)	=	15 mm
r_1	=	Corner radii on shaft and housing
r_1	=	1 (From design data book)
Maximum Speed	=	14,000 rpm (From design data book)
Mean Diameter (d_m) =	=	$(D + d) / 2$
	=	$(35 + 15) / 2$
d_m	=	25 mm

3.2 Length of piston rod:

Approach stroke	=	160 mm
Length of threads	=	$2 \times 20 = 40$ mm
Extra length due to front cover	=	12 mm
Extra length of accommodate head	=	20 mm
Total length of the piston rod	=	$160 + 40 + 12 + 20$
	=	232 mm
By standardizing, length of the piston rod	=	230 mm

3.3 Design of Pneumatic Cylinder

Force to be exerted is 40N

$$\begin{aligned} \text{Force} &= \text{pressure} \times \text{area} \\ \text{Pressure in the cylinder} &= 0.4 \times 10^5 \text{ N/m}^2 \\ \text{Area of the piston, } (\pi d^2)/4 &= \frac{\text{Force}}{\text{pressure}} \end{aligned}$$

$$\text{Bore diameter} = 40 \text{ mm}$$

From Janatics pneumatic products catalogue we have selected 40mm bore diameter cylinder

4. Design of spur gear

4.1 Speeds in gear box:

Measured Specifications:

$$N1/N2 = D2/D1$$

Where,

$$N1 = \text{Motor speed in RPM} = 60 \text{ RPM}$$

$$N2 = \text{Output speed}$$

$$D2 = \text{Diameter of the big gear wheel} = 200 \text{ mm}$$

$$D1 = \text{Diameter of the small gear wheel} = 32 \text{ mm}$$

$$\therefore N2 = (D1/D2) \times N1$$

$$= (32 / 200) \times 60$$

$$= 9.6 \text{ rpm}$$

$$= 10 \text{ rpm}$$

4.2 Pneumatic cylinder

Specification (From Janatics Product Catalogue)

Operating pressure – 8-10 N/m²

Outer Diameter – 45 mm

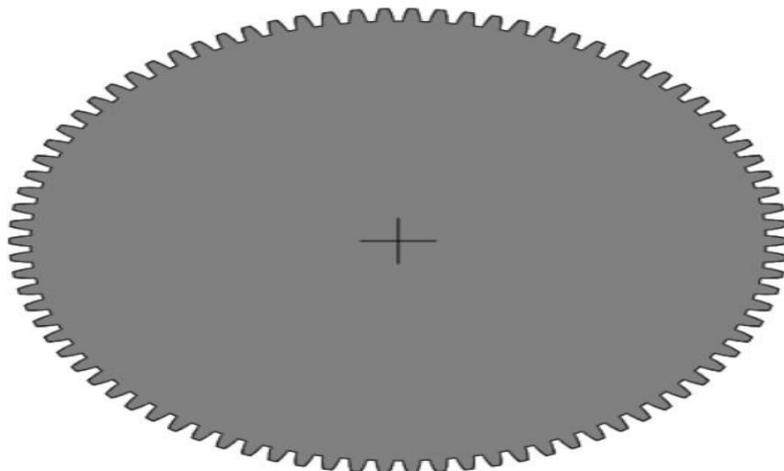
Inner Diameter – 40 mm

Stroke length – 160 mm

5. Design of gear wheel

Spur gear

Metric and Imperial Unit Spur Gear Generator



Input Parameters		Geometry		Display	
Module	2	Pitch Diameter	172 mm	Pitch Circle	<input type="checkbox"/>
Num. Teeth	86	Base Diameter	167.2 mm	Base Circle	<input type="checkbox"/>
Pressure Angle	14.5 deg.	Outer Diameter	176 mm	Dedendum	<input type="checkbox"/>
	csv <input type="button" value="Export"/>	Addendum (nom)	2 mm	Addendum	<input type="checkbox"/>
		Dedendum (nom)	2.4 mm	Tooth Sector	<input type="checkbox"/>
		Tooth Thickness	3.141 mm		

6. Specification

6.1. Double acting pneumatic cylinder

Technical Data

Stroke length	:	Cylinder stoker length 160 mm = 0.16 m
Quantity	:	1
Seals	:	Nitride (Buna-N) Elastomer
End cones	:	Cast iron
Piston	:	EN – 8
Media	:	Air
Temperature	:	0-80 ° C
Pressure Range	:	8 N/m ²

6.2 Manual Valve

Technical data

Max pressure range	:	0-10 x 10 ⁵ N/m ²
Quantity	:	1

6.3 Flow control Valve

Technical Data

Port size	:	0.635 x 10 ² m
Pressure	:	0-8 x 10 ⁵ N/m ²
Media	:	Air
Quantity	:	1

6.4 Hoses

Technical data

Max pressure	:	10 x 10 ⁵ N/m ²
Outer diameter	:	6 mm = 6 x 10 ⁻³ m
Inner diameter	:	3.5 mm = 3.5 x 10 ⁻³

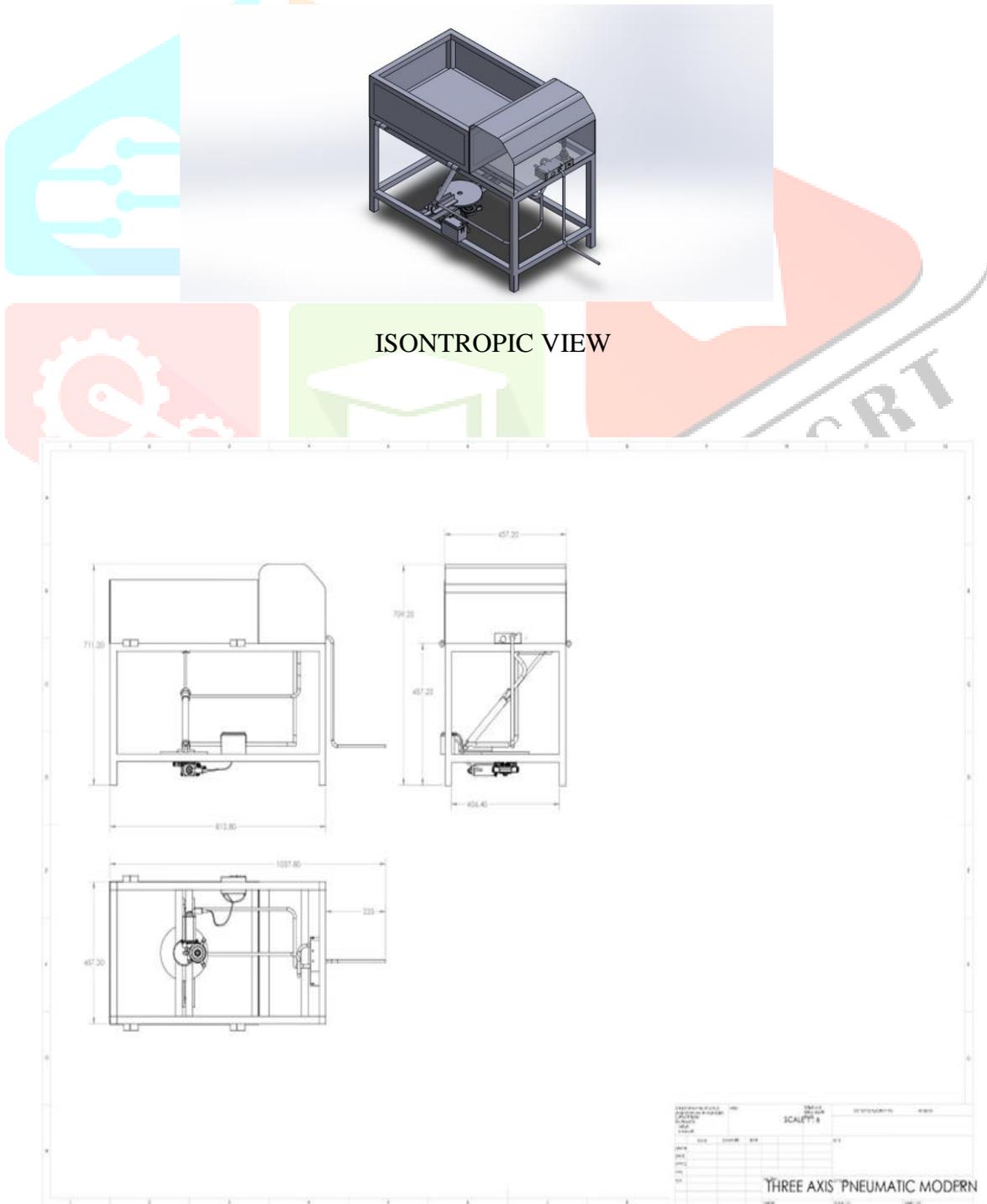
7.1 Working principle

A direction control valve and a switch are provided at the dash pad. The direction control signal is used to control the pneumatic cylinder in the forward and the reverse direction. The switch is used to control the motor. The motor is started which is coupled with the pneumatic cylinder. The air is sucked from the compressor. The compressed air goes to the pneumatic cylinder. The compressed air pushes the pneumatic cylinder piston making it to move forward. The RAM is fixed at the end of the single acting pneumatic cylinder. The piston moves towards upward and the ram is lifting the tray. When the direction control valve is activated in the reverse direction, the pneumatic cylinder retards and the lifting tray comes down. For the movement of the trailer in the three axes, the pneumatic cylinder must be rotated in such direction and must be actuated. For the rotation of the cylinder a motor with the spur gear is provided which is operated by the switch. The cylinder is turned in the relative direction and is actuated so that the trailer is lifted in the corresponding axis. The movable frame consists of a pneumatic cylinder, Spur Gear and universal joint for rotating and lifting the trailer. The Spur Gear Mechanism meshed with DC Motor makes the tray to rotate about the three directions. The cylinder should be turned opposite direction to the Dumping axis and the hinges on the dumping axis should be locked meanwhile other hinges should be unlocked. This hinge connects the tray with the frame and the pressure from the cylinder makes the tray to be lifted in the desired axis.

7.2 Three way mechanism

Three-way tipper can unload materials in all three sides. Also, we require special types of hinge joints in this case as mentioned earlier. 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 (2,3) cylinders are placed on along lateral side of the chassis at appropriate distance for left and right-side tilting of the trolley.

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 no.H1, H2, H5 and H6 must be disconnected manually by pulling pin from the hinge, for this hole of 8 mm. diameter is provided on pin head to facilitate manual pulling by inserting rope inside the pin hole. For this operation cylinder 2 and 3 are not in working. The maximum angle of turn made by trolley with horizontal for effective backside unloading of loose material is 45 degree



8. Conclusion

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries. We are proud that we have completed the work with the limited time successfully. The “THREE AXIS PNEUMATIC MODERN TRAILER” is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality.

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- [6][Roshan A. Jadhao, Dhananjay D. Jawalekar] Compressed air is used to activate the pneumatic cylinder, when the valve is activated. the efficiency of dumping trailers will increase
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