ISSN XXXX XXXX © 2017 IJESC

IJESC

Research Article Volume 7 Issue No.7

Fabrication of Hydraulic Lift Vehicle

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Abstract:
The idea of making this project comes from when we look an expensive sport car which is unable to run on Indian roads due to its low ground clearance. In this project the chassis of vehicle is lifted by the use of hydraulic pressure .Due to this lift of chassis the ground clearance of vehicle is increased so that it is able to overcome all the obstruction during drive like speed breaker, broken roads etc. and saves the cars from damage. In this project the lift of chassis is done during running condition not even without stopping the vehicle. The lift time of chassis is decided by the manually by button or pulling lever. The lift of chassis is done by the hydraulic piston cylinder assembly.

Keywords: Ground Clearance, Hydraulic Lift, Hydraulic Piston & Cylinder Assembly.

I. INTRODUCTION

In the hydraulic lift vehicle the chassis of vehicle is lifted up to 2 inch. This lift is done by the use of hydraulic pressure exerted by four piston cylinder assembly mounted on each wheel. The fluid is pumped by two 12v DC car fuel pumps into the piston cylinder assembly. Its works on the Pascal's law which states that "If pressure is increased at any point in confined fluid, then equal increased in pressure at every other point in the container". In this vehicle the driver see all the obstruction coming in front of vehicle and manually pull the lever or press the button and lift the chassis. The power plant of the vehicle is two heavy torque DC gear motor. Both having 60 rpm and 10 kgfcm torque. One motor is used for front motion and another motor is used for steering the vehicle. For steering the vehicle one battery is connected to rack and pinion which is placed horizontally to vehicle and connected to both wheels. The movement of rack and pinion turn the tires and vehicle. All the pumps and motors is powers by two 7.2A battery. During lift the angular power transmission is done with the help of four universal joints. .

II. LITERATURE REVIEW

In 1954 citron 15cvh was the first vehicle which comes in production. This vehicle featured a self leveling, height adjustable hydro pneumatic suspension Since this time, these systems have appeared continuously on Citron models, including the DS and CX[1].

In 1959 Ron Aguirre is first person to create a custom car with hydraulically adjustable suspension. He take the Pesco pumps and valves from from discarded material and adapted them to the front suspension of his X-Sonic bubble-topped custom corvette, allowing him to change the height of the car with a switch on the dashboard [1].

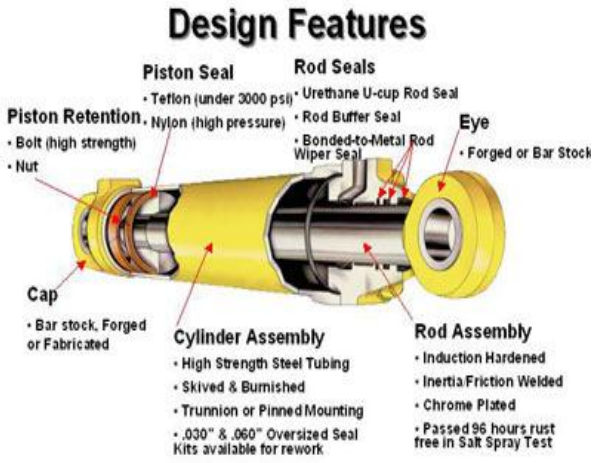
Some of cars use the same systems to improve the vehicle's handling by lowering the vehicle's height during higher speeds for example Mercedes active body control system. Another example is the Audi a8, which when driven at speeds of more than 120 km/h for more than 30 seconds reduces its clearance from 120 mm to 95 mm[11].

III. MATERIALS & METHODS

The components used in this project are described below:

i. HYDRAULIC PISTON AND CYLINDER ASSEMBLY

Number of hydraulic cylinder assembly = 4
Size of piston cylinder assembly = 20*120 mm (where 120 is stroke length)
A hydraulic cylinder is a mechanical actuator which is used to give a unidirectional (one directional) force through a unidirectional stroke. It has lots of applications, manufacturing machinery, civil engineering and notably in construction equipment. Hydraulic cylinders get their power from pressurized fluid, which is typically oil (it may be depend on conditions). The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom and the other end is closed by the cylinder head where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber and the other is piston rod side chamber.



Lugs, trunnions, clevises, flanges are common cylinder mounting options. The piston rod also has mounting attachments to connect the cylinder to the object or machine component that it is pushing / pulling.

ii. Chain power transmission

Number of sprocket = 2
Pitch = 12.7mm
Width = 2.4mm
Teeth = 18

Chain drive is a way of transmitting power and motion from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. The power is conveyed by a roller chain, known as the drive chain passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

iii. DC GEAR MOTOR

Number of motors = 2
Speed = 60rpm
Torque = 10kgfcm

A DC motor converts direct current electrical energy into mechanical energy. The forces produced by magnetic fields. Generally all types of DC motors have some internal mechanism, either electro-mechanical or electronic, for periodically change the direction of current flow in part of the motor.

Direct Current motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be varies over a wide range, using either a variable supply voltage. Small DC motors are used in tools, toys, and appliances like toy cars, trimmers etc. The universal motor can be operated on DC but is a lightweight motor used for portable power tools and appliances. Larger DC motors are used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills in manufacturing process. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

iv. FUEL PUMP

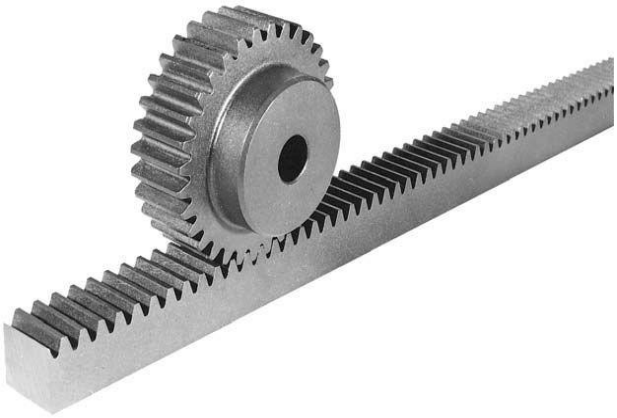
Number of fuel pump = 2
Voltage = 12v DC
Flow = 190L/hr
Pressure exerted = 100psi

A fuel pump is a essential component on a car or other IC engine device. Many engines do not require any kind of fuel pump at all, because of gravity to feed fuel from the fuel tank or under high pressure to the fuel injection system. Often, carburated engines use low pressure mechanical pumps which is mounted outside the fuel tank, whereas fuel injected engines often use electric fuel pumps that are mounted inside the fuel tank and some fuel injected engines have two fuel pumps: one low pressure/high volume supply pump in the tank and one high pressure/low volume pump on or near the engine.

v. RACK & PINION

Number of rack & pinion = 1
Pitch = 8mm
Width = 1 inch

A rack and pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion. Rack and pinion combinations are often used as part of a simple linear actuator, where the rotation of a shaft powered by hand or by a motor is converted to linear motion.



The rack carries the full load of the actuator directly and so the driving pinion is usually small, So that the gear ratio reduces the torque required. This force, thus torque, may still be substantial and so it is common for there to be a reduction gear immediately before this by either a gear or worm gear reduction. Rack gears have a higher ratio, thus require a greater driving torque, than screw actuators.

Method

In this vehicle the hydraulic lift of vehicle chassis is done by four piston cylinder assembly mounted on each wheel. The fluid used in the lifting is water. But brake oil can be used for better work. Firstly when a driver sees a obstacle then he press the button or pull the liver. After this the pumps get on and start pumping the water which is held in a container .The pump takes water from container and pumps it into piston cylinder assembly then piston moves bottom dead center to top dead center and all four piston assembly connected to chassis so movement of piston uplift the chassis. After that when vehicle passes the obstacle then driver switch off the pump so due to

weight of vehicle the piston moves downward and chassis gets its initial position.

(Hydraulic lift vehicle is shown in figure)

Fabrication

The fabrication process takes the following steps:

Step 1

For making of chassis a hollow 10 feet square rod is cut into 4 pieces. 2 pieces cut 2 feet long and remaining 2 pieces cut 3 feet long.

Step 2

After that all pieces welded in rectangular form by arc welding and after that A 2*3 feet rectangular is ready.

Step 3

From the front 6 inch backward from both sides i.e. right and left two 13 inch wheel is connected by nuts and bolts through universal joints and that joint is connected to chassis from another side but the motion of universal joints is restricted in vertical direction. Similarly same thing is done at backward sides.

Step 4

A DC gear motor having 10kgfcm torque and 60 rpm is attached in front of frame. This gear motor is connected to a rack and pinion having 1 inch width and 8mm pitch. and the rack and pinion is connected to leaf from both sides and that leaf is connected to wheels for providing it flexible motion.

Step 5

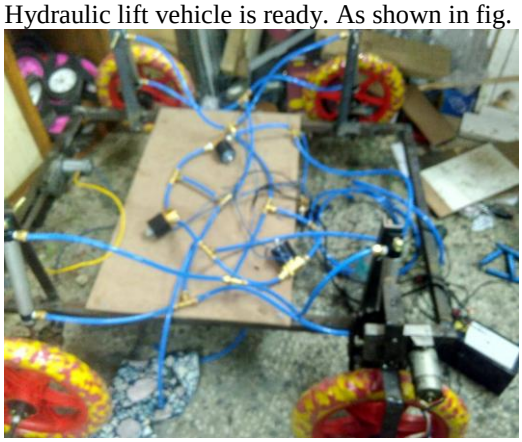
4 angles having 10 inch height is welded in chassis. 2 is welded 6 inch backward from the front of chassis in both sides and 2 is welded 6 inch forwarded from back sides of chassis. After that piston cylinder is attached in this angles from the top it fix with the help of nut and bolts and from the bottom all piston cylinder assemblies is welded

Step 6

In the left backward wheel for power transmission another DC gear motor is attached with nuts and bolts that motor is connected with a sprocket and this sprocket is connected with the sprocket of wheel by chain both sprocket having 18 teeth each. As shown in fig.

Step 7

Hydraulic lift vehicle is ready. As shown in fig.



Result & Discussion

- Calculation of weight lifting capacity of vehicle

Diameter of cylinder = 20mm
Radius of cylinder(r) = 20/2= 10mm
Area of cylinder = $\pi*r^2$= 3.14*10*10=314mm^2
Fluid pressure to required lift load = weight to be lifted / cylinder area
=1 kg/314mm^2
(1kg=2.2046 pound and 314mm^2 = 0.486701 inch^2)
=2.2046/0.48671=4.5296psi
Pump exerted pressure = 100psi
So lifting capacity = 100/4.5296=22.0799 pounds (10.015 kg)
22.0799 pounds (10.015kg) is lifting capacity of single cylinder.
Hence,
Lifting capacity of 4 cylinder = 22.0799*4= 88.319 pounds (40.0608 kg)
TOTAL LIFTING CAPACITY OF VEHICLE= lifting capacity-weight of chassis=88.319-11.0231
=77.2959 pounds **(35.0608kg)**

- The ground clearance of the vehicle is increased by 2 inch along the obstacles. It is prevented from being damaged.
- The average time required by the system to vary the ground clearance of the vehicle is 3 seconds (Measured by stopwatch).

IV. CONCLUSION

By implementing the ground clearance adjustment system number of damages to the vehicle chassis is greatly reduced. Below are some of the conclusions based on new derived process and new design:

- Smooth drive is obtained.
- The system comes into work when barrier come in the range.
- The model is compact with low cost and safety.

V. FUTURE ASPECT

- A sensor can be used for automatic lift.
- More powerful cylinder can be used for better height lift and better load lift.

VI. ACKNOWLEDGMENTS

The authors thanks to the management and faculties of mechanical engineering department of SCE Dehradun, for their support for completion of this project.

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