“A CASE STUDY ON IMPLEMENTATION OF HYDRAULIC JACK TO HEAVY LOADED VEHICLES”

PROJECT REFERENCE NO. : 37S1373

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Keywords:

Introduction:

A hydraulic jack is a device used to lift heavy loads. The device itself is light, compact and portable, but is capable of exerting great force. The device pushes liquid against a piston; pressure is built in the jack's container. The jack is based on Pascal's law that the pressure of a liquid in a container is the same at all points.

Innovative changes have taken place in Fluid power technology and this is because electronic components are used to control hydraulic components. With the aid of technology, preference is now being given to luxury, comfort and safety. This Mechanical Engineering Final Year project “Implementation of Hydraulic Jack to Heavy Loaded Trucks/Vehicles” works on the principle of Pascals Law, Hydraulic Force & Pressure.

Whenever the vehicles is static condition the vehicles exerts point load on tire due to this load the wear of the tire takes place. So that the present of hydraulic jack increases the life of the tire and also it helps in reduction of transportation cost. And also it helps the user for changing of tires whenever they were busted or punctured. Hydraulic jack system is attached to automobile vehicle on front and rear part of the chassis. An automobile hydraulic jack system can be easily attached to all currently manufacture automobile chassis and frames.
Objectives of the project:

1) To reduce the point load acting on a tyre of a heavy loaded truck.
2) To increase the life and strength of a tyre.
3) To reduce the wear and tear of the tyre.
4) To reduce the transportation cost.
5) It is helpful for the driver to lift and drop the jack with a single button.
6) It will be easy to remove and fix the tyre in case of a inflated.

Methodology:

In our present project we are designing a motor and a hydraulic jack to lift the heavy loaded vehicles this jack will be automated and is assembled to the chassis of the vehicles so that there is no need to place the jack under the vehicle and the control lever or buttons for operating this will be provided in the drivers cabin. the mechanism of working will be shown in the figure 3.1a below.

Hydraulic Jack

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pressure is built in the jack's container. The jack is based on Pascal's law that the pressure of a liquid in a container is the same at all points.

Innovative changes have taken place in Fluid power technology and this is because electronic components are used to control hydraulic components. With the aid of technology, preference is now being given to luxury, comfort and safety.
Working:

Case 1: when front wheel of the vehicle gets punctured

In the case of front wheel of the vehicle gets punctured, we lift wheel using the switch which provides the connection to the hydraulic pump system. When we operate the front wheel switch, hydraulic pump system takes drive from the propeller shaft of the vehicle and hydraulic pump produces high pressure energy. Hydraulic fluid in hydraulic pump system at high pressure moves to the front wheel jack through the hose pipe and lifts front wheel of the jack.

Case 2: when rear wheel of the vehicle gets punctured

In the case of rear wheel of the vehicle gets punctured, we lift wheel using the switch which provides the connection to the hydraulic pump system. When we operate the rear wheel switch, hydraulic pump system takes drive from the propeller shaft of the vehicle and hydraulic pump produces high pressure energy. Hydraulic fluid in hydraulic pump system at high pressure moves to the rear wheel jack through the hose pipe and lifts rear wheel of the jack.

Pump Calculations:

Vehicle ranging of weight of 2-20 tons

We know that

\[ F = MA \]

Where:

\[ M = 20000 \] \( \text{kg} \)
\[ A = 9.8 \] \( \text{m/s}^2 \)

Therefore

\[ F = 20000 \times 9.8 = 196000 \] \( \text{kg m/s}^2 \)

\[ \text{kg m/s}^2 = 1 \] \( \text{N} \)

Then

\[ F = 196 \] \( \text{KN} \)

Consider the distance of lift = 500 mm

Hence \( \text{torque} = F \times D = 9800 \) \( \text{N-m} \)

Then

\[ T = \frac{PVd}{2\pi} \] \( \text{N-m} \)
Where

\[ V_d = \frac{\pi}{4}(D_o^2 - D_i^2)L \ldots m^3 \]

\( D_o = 48\text{mm} = \text{outside diameter of gear teeth} \)

\( D_i = 32\text{mm} = \text{inside diameter of gear teeth} \)

\( L = 25\text{mm} = \text{width of displacement} \)

\( V_d = \text{displacement volume of pump} \)

\( V_d = 2.54 \times 10^{-5} \ldots m^3 \)

Then

\[ T = \frac{PV_d}{2\pi} \]

\[ P = \frac{9800 \times 2\pi}{2.54 \times 10^{-5}} \]

\[ P = 2420 \ldots \text{MPa} \]

**Results and Discussions:**

To derive vertical components of strain, contact patch geometry and pressure distribution of the tyre under different inflation pressures and loads, the same tyre used for physical experiments was modelled on a rigid road. Analysis of the results predicted by the FE tyre model can provide three-dimensional vertical components of strain and contact pressure fields under different inflation pressures and loading conditions. Fig. 7.1a– illustrates the vertical components of strain derived from the model for each of the four combinations of inflation pressure and load. 15–100 identifies a load of 15 kN and an inflation pressure of 100 kPa. Similarly, 15–250 refers to at load of 15 kN and inflation pressure of 250 kPa. The other combinations simulated were 25–100 and 25–250. The labels SMN and SMX describe the minimum and maximum strain values of the plotted item, respectively. DMX identifies the maximum deformation (units of mm) as reported in the Graphics window.
Table 7.1a: Load, inflation pressure combination, tyre deformation, and measured and predicted tyre contact length

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Load (kN)</th>
<th>Inflation pressure (kPa)</th>
<th>Normal deflection (mm)</th>
<th>Measured mean contact length (mm)</th>
<th>Predicted mean contact length (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15–100</td>
<td>15</td>
<td>100a</td>
<td>47</td>
<td>450</td>
<td>445</td>
</tr>
<tr>
<td>15–250</td>
<td>15</td>
<td>250b</td>
<td>20</td>
<td>345</td>
<td>360</td>
</tr>
<tr>
<td>25–100</td>
<td>25</td>
<td>100c</td>
<td>90</td>
<td>660</td>
<td>640</td>
</tr>
<tr>
<td>25–250</td>
<td>25</td>
<td>250a</td>
<td>42.5</td>
<td>500</td>
<td>520</td>
</tr>
</tbody>
</table>
Conclusions:

The main aim of this project is to implementation of hydraulic jack to a heavy vehicles, due to these heavy loads on a vehicles the life the tyre will be reduced. Whenever the vehicles is static condition the vehicles exerts point load on tyre due to this load the wear of the tyre takes place. So that the present of hydraulic jack increases the life of the tyre and also it helps in reduction of transportation cost. And also it helps the user for changing of tyres whenever
they were busted or punctured. Hydraulic jack system is attached to automobile vehicle on front and rear part of the chassis. An automobile hydraulic jack system can be easily attached to all currently manufacture automobile chassis and frames. There is a front suspension hydraulic jack that is mounted centrally to the front suspension of an automobile between its front wheels. There is also a rear suspension hydraulic jack that is mounted centrally to the rear suspension of the automobile between its rear wheels. The system operates from a compressed fluid reservoir tank that has connections for the front and rear car jack outlets. Additional outlets can be added to the compressed fluid reservoir tank for connecting a hydraulic lug wrench and another for a tire inflating hose.

**Scope for Future Work:**

The arrangement of inbuilt hydraulic jack system is designed for heavy loaded trucks in this project work, but this arrangement can be widely use in future for heavy vehicles also by making some small modifications in current project.