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Design And Evaluation Of Hydraulic Suspension Without Spring In LMV

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Abstract **-** The suspension is the backbone of all vehicles its principle function is to safely carry the maximum load for all designed operating conditions. This project defines design and evaluation of hydraulic suspension without spring in LMV. Shock reduction is an important characteristic which reduces the vibration of the vehicle and carries the load safely. In this project a hydraulic suspension is used to produce hydraulic pressure that negates external forces acting on the vehicle. As a result, the suspension system is able to control vehicle movement freely and continuously. This control capability makes it possible to provide higher levels of ride comfort and vehicle dynamics which obtained with conventional suspension systems. The design was done using CREO PARAMETRIC 2.0 and the model is imported to Proficy / SCADA (IFix version 4.0) for evaluation. The major features of the hydraulic system include

- Active bouncing control using by this system,
- A frequency-sensitive damping mechanism and active control over roll dive.

Keywords- It achieves smooth ride travel,types of suspension,Control valve,Hydraulic suspension.

INTRODUCTION

"It is difficult to imagine a human societywithout the ease of transportation facilities provided by way of the automobiles. The idea that for millennia people managed to live on, or even to thrive, without this sort of contraption is unbelievable to many in today's world"

While the vehicle moving on the road the wheels are thrown up and down due to the irregularity of the road. This results in strain on the components of the vehicle and the passengers. To prevent damage to the working parts and also to provide riding comfort, suspensions is used in the vehicle. The suspensions system of a motor vehicle is divided into the rear-end suspension and front end suspension.

PROBLEM IDENTIFICATION

The following Problems are concluded from the study of literature review.

- From the entire study of the literature survey, it was found that in most of the vehicle load carrying capacity is based on the suspension.
- Apart from that safe driving plays an important role in automobile. When the level of suspension reduces it leads to increase in noise.
- By using hydraulic suspension we can reduce the vibration and also improve riding comfort.

Auto manufacturers are still trying to catch up with the combination of features offered by this hydraulic suspension system, typically by adding layers of complexity to an ordinary steel spring mechanical system.

ACTIVE SUSPENSION

A. *INTRODUCTION OF ACTIVE SUSPENSION*

A suspension is self-propelledequipmentit controls the upright movement of all the wheels via an onboard system reasonably than the effort being determined entirely by the surface on which the car is driving. The system is able to control vehicle movement freely and continuously in many driving situations including cornering, accelerating, and braking.

B. TYPES OF ACTIVE SUSPENSION

Active suspensions can be generally divided into two main classes:

a. Pure active suspensions and
b. Semi-active suspensions.

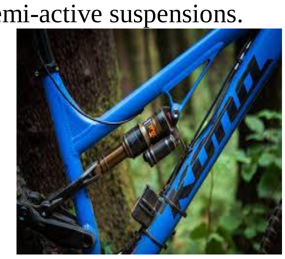

Fig I: Pure Active Suspensions

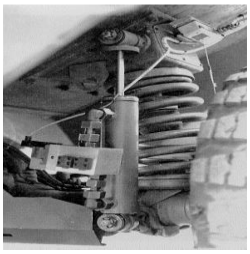

Fig II: Semi-ActiveSuspensions

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COMPONENTS OF HYDRAULIC SUSPENSION

A.INTRODUCTION OF HYDRAULIC SYSPENSION

Hydraulic suspension is a type of automotive suspension device. The motive of this device is to provide a smooth, relaxed, yet nicely-controlled ride excellent. Its nitrogen springing medium is approximately six instances greater bendy than conventional metallic, so self-leveling is included to allow the car to cope with the brilliant suppleness supplied. That the hydraulic suspension converts the hydraulic strength into mechanical strength. in lots of fluid energy programs, we want to transform the strain energy of liquid into mechanical electricity to perform beneficial paintings. This function is finished with the aid of the devices known as actuators.

B.MAIN COMPONENTS USED IN HYDRAULIC SUSPENSION

1.Double Acting Hydraulic Cylinder
2.Pilot-Operated Sequence Valve
3.Sensors
4.Hydraulic Pump
5.Flow Control Valve
6.Direction Control Valve
7.Pressure Gauge

Double Acting Hydraulic Cylinder

A hydraulic cylinder is a fluid motor that generates linear motion. In other words, hydraulic cylinder is a device which converts fluid power into linear mechanical force and motion. The hydraulic cylinders are basically used for performing work such as pushing, pulling, tilting, and pressing in a variety of engineering applications such as in material handling equipment machine tools, construction equipment, and automobiles.

In the double-acting hydraulic cylinders, liquid pressure can be applied to either side of the piston, thereby providing a hydraulic force in both directions. The double-acting cylinders are mostly used in applications where larger stroke lengths are desired.

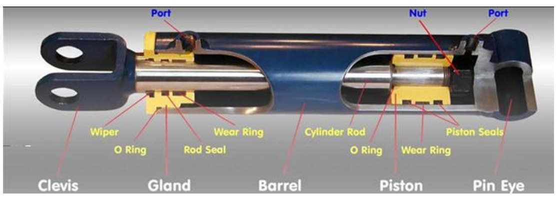


Fig I: Hydraulic Cylinder

Pilot-Operated Sequence Valve

When the system inlet pressure is within the present valve pressure, the valve allows the fluid freely through the primary port to operate the first phase. When the system inlet pressure exceeds the present valve pressure, the valve spool moves up. As the spool lifts, flow is diverted to the secondary port to operate the second phase.

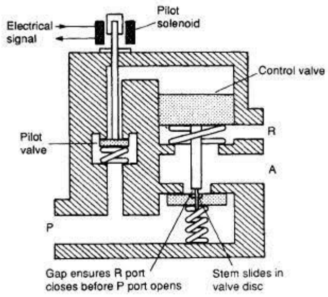


Fig II: Pilot-Operated Sequence Valve

Sensors

A position sensor is used for measure the linear movements of elements have to be exactly positioned. The sensors assure reliable operation in many sectors of automation and processing, as well as in the field of industry and automotive. Position sensors can also measure the linear, angular, or multi-axis position.

Hydraulic Pump

A hydraulic pump is a mechanical device that converts mechanical power into hydraulic energy. It generates flow with enough power to overcome pressure induced by the load. When a hydraulic pump operates, it performs two functions.

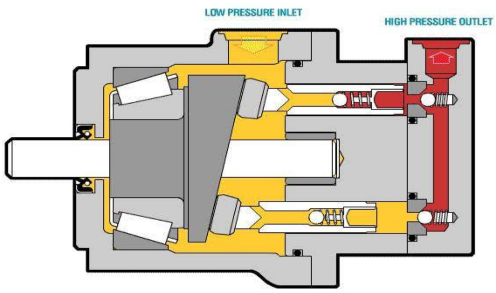


Fig III: Hydraulic Pump

Flow Control Valve

Flow control valves, also known as **volume-control valves,** are used to regulate the rate of fluid flow to different parts of a hydraulic system. Since control of flow rate is a means by which the speed of hydraulic machine elements is governed, therefore control valves are also known as **speed-control valves.** The flow rate to a particular system component is varied by throttling or by diverting the flow.

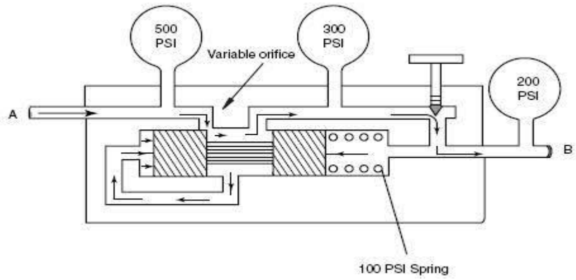


Fig IV: Flow Control Valve

Direction Control Valve

Directional control valves are one of the most fundamental parts in hydraulic machinery as well as pneumatic machinery. They allow fluid flow into different paths from one or more sources. They usually consist of a spool inside a cylinder which is mechanically or electrically controlled.

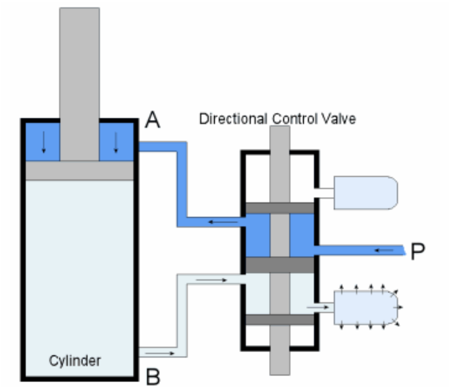


Fig V: Direction Control Valve

Pressure Gauge

Pressure gauge is the analysis of an applied force by a fluid (liquid or gas) on a surface. Pressure is typically measured in units of force per unit of surface area. Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called pressure gauges or vacuum gauges.

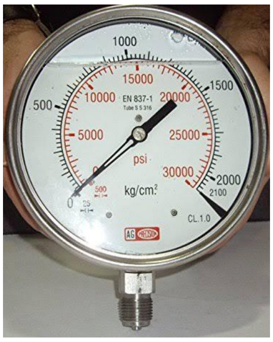


Figure VI: Pressure Gauge

PROPERTIES OF HYDRAULIC LIQUID

A. *LHM (Liquide Hydraulique Mineral)*

The brake fluid was not suitable for high pressure hydraulic systems, because it realized quickly. So LHM fluid is used instead of brake fluid. LHM is a mineral oil, which is nearlyequal toautomatic transmission fluid. Mineral oil will not absorb any moister from the air, compare to standard brake fluid, so the water particles does not affect the system, and creates 'spongy' brake feel. So the mineral oil has its vast application in, Rolls-Royce, Peugeot, and Mercedes-Benz, to include Jaguar, Audi, and BMW. The chief problem with red LHS (the fluid previously used, similar to conventional DOT3 brake fluid), is that the water it absorbs produces corrosion in the system. Most hydraulic brake systems are sealed from the outside air by a rubber diaphragm in the reservoir filler cap, but the system was never sealed.

- The mineral Hydraulic liquid is used in all hydraulic brake system which preferred by all manufacturer.
- Properties & Advantages
- Stability is high
- Lubricating power is excellent
- Elevated boiling point and non-hygroscopic

Table I Main Characteristics Of LHM

	Units	Typical Values
Colour		Light green
Density at 20°C	kg/m^3	844
Kinematic viscosity at 40°C	mm²/s	18,3
Kinematic viscosity at 100°C	mm²/s	6.2
Viscosity index		336
Pour point		< -50

B. *Manufacturing of LHM*

THE WHOLE HIGH PRESSURE PART OF THE SYSTEM IS MANUFACTURED FROM STEEL TUBING OF SMALL DIAMETER, CONNECTED TO VALVE CONTROL UNITS BY LOCKHEED TYPE PIPE UNIONS WITH SPECIAL SEALS MADE FROM DESMOPAN RUBBER, A TYPE OF RUBBER COMPATIBLE WITH THE LHM FLUID. THEMOVING PARTS OF THE SYSTEM E.G. SUSPENSIONS STRUT OR STEERING ARM.

C. CALCULATION FOR SELECTION OF DOUBLE ACTING HYDRAULIC CYLINDERS

Formula

$$P = F/A \ N/m^2$$

where

P – Pressure N/m^2
F – Force N (or) kg
A – Area m^2

Model Calculation

Diameter of the bore (D) = 0.06 m

Area (A)= (π /4) D^2
= (π /4) 0.06^2
A=0.002827 m^2

Total Pressure (P) = 9810/0.002827
P **= 34, 70, 109.65 N/m^2**
P = **503.3 psi**

Pressure for Individual Cylinder (P) **= 125.8 psi**

Force due to vibration = Force due to vehicle
Pressure = Force due to vehicle weight/Area

D. ITEMS SPECIFICATION

1. DOUBLE ACTING HYDRAULIC CYLINDER

3000 PSI SERIES -- A250160ABAAA07B

FigI: Double Acting Hydraulic Cylinder

Max. Stroke	: 0.41 m
Pressure	: 3000 psi
Bore Size	: 0.06 m
Cylinder Configuration	: Simple
Cylinder Action	:Double
Features	:Integral Sensor (optional feature)
Mounting Method	: Clevis Mount
Mount Location	: Cap and Head
Cylinder Style	: Tie-Rod

2. PILOT OPERATED SOLENOID VALVE

Fig II: Pilot Operated Solenoid Valve

Maximum Pressure	: 3000 psi
Number of Ports	: 2
Power	: 14 to 30 volts
Power Connection Description	: 75A Max. @ 28VDC
Unpowered State	: Normally Open
Valve Type	: Single Solenoid; Cartridge
Media	: Hydraulic

3. LIQUIDE HYDRAULIQUE MINERAL

Typical PropertiesFluid viscosity

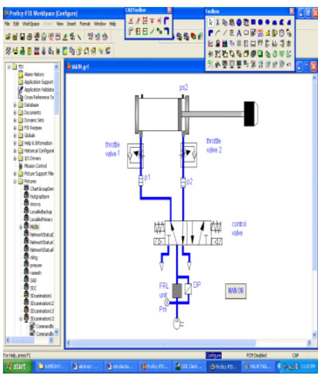
Viscosity @ 25° C	:	84.00 centistoke
Viscosity @ 40° C	:	45.00 centistoke
Viscosity @ 100° C	:	9.00 centistoke
Viscosity Index	:	192
Pour Point, °C max	:	-46
Zinc, wt. %	:	0.17

HYDRAULIC CIRCUIT

A hydraulic circuitmay be defined as the graphic representation of the hydraulic components in a hydraulically operated machine. In other words, a hydraulic circuit is an arrangement of interconnected components (such as pumps, actuators, control valves, and piping's), selected to achieve the desired work output. The passive component such as pipes or transmission lines or active components such as power packs or pumps are discrete and linear. This usually means that hydraulic circuit analysis works best for long, thin tubes with discrete pumps, as found in chemical process flow systems or micro scale devices.

A. HYDRAULIC CIRCUIT DRAWN BY SCADAHYDRAULIC SOFTWARE

a) MAIN WINDOW b) RUN MODE



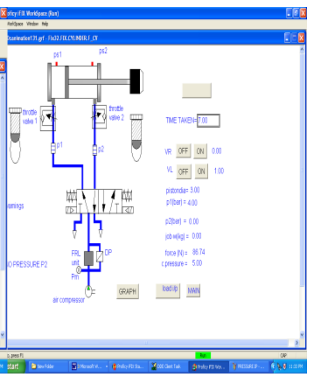


Figure III :Main Window ***Figure IV : Run Mode***

GRAPHWINDOW- CONFIGURE MODE

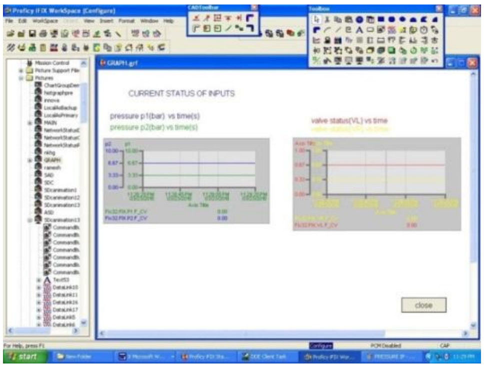


Fig V : Comparison of Pressure Vs Time In Configure Mode

GRAPH WINDOW-RUN MODE

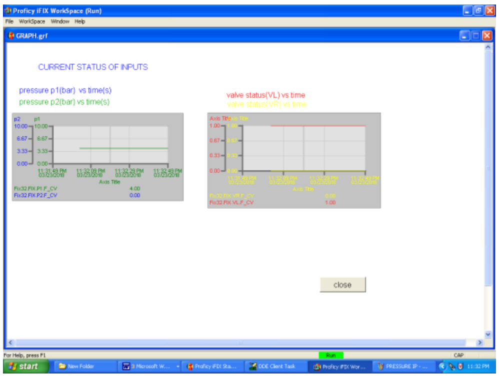


Fig VI : Comparison of Pressure VsTime In Run Mode

FUNCTION OF CIRCUITS

Diagram of the Hydractive system, showing centre spheres and stiffness valves.

Top left - suspension in "soft" state; the solenoid valve (1) is energized, the slide valve opens allowing hydraulic fluid to flow between the suspension cylinders and the spheres (4 and 3) via the dampers (6). All six spheres are in use Bottom left - suspension is in "firm" mode; the solenoid valve (1) is not energized, the slide valve takes up a position which blocks the movement of hydraulic fluid between the two main spheres(4) on each axle and isolates the additional spheres (3) from them both.

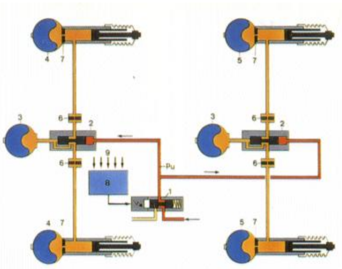
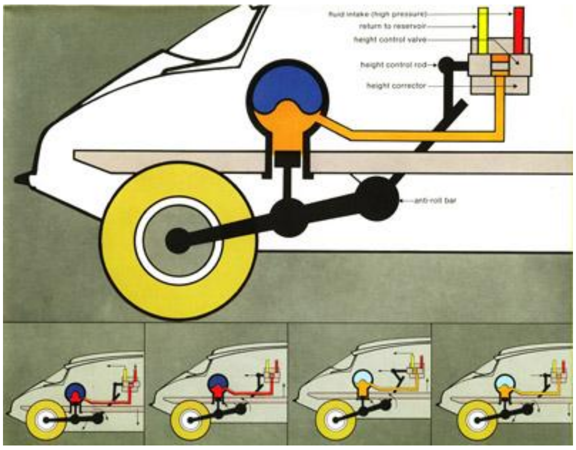


Figure VII : Function of Circuits

BLOCK DIAGRAMS OF HYDRAULIC SUSPENSION ARRANGEMENT



CONCLUSION

By using this hydraulic suspension we can negates external forces acting on the vehicle with the help of hydraulic pressure. Through analysis we can determine its capacity of handling down forces. Obviously we can able to control vehicle movement freely and continuously. This control capability can make higher levels of ride comfort and vehicle dynamics, which was obtained with conventional suspension systems (coil or leaf spring).

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