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Development of Advanced Hydro-Pneumatic Suspension System

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A B S T R A C T

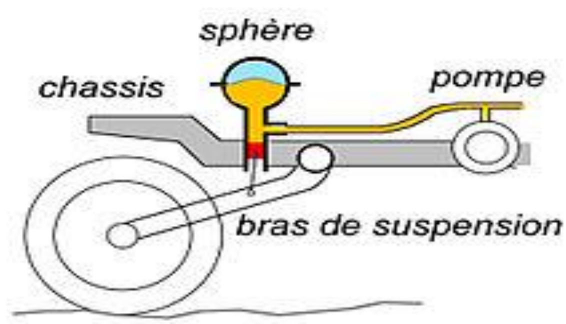
The point of this paper is to foster model containing the hydro-pneumatic suspension framework for four wheelers and weighty vehicles. The hydro-pneumatic framework utilizes a gatherer to create spring force (like the Hydro Active suspension arrangement of Citroën) and a distant valve block to create damping force. A water powered chamber replaces the damper swagger and springs of the vehicle. The chamber creates oil volume uprooting towards the collector. The oil is thought to be incompressible and the volume of the air chamber inside the collector is lessened which makes a tension increment through the "best gas regulation".

Keywords:Pressure, Bench Vice, Compressor

1.Introduction

Suspension framework is most significant in a vehicle which counters the unsettling influences produced from the street. It contributes fundamentally on the vehicle's soundness, security and control. The principal parts of Hydro-pneumatic suspension framework are gatherers, chambers, stream resisters, lines and fittings. The essential format of the hydro-pneumatic suspension framework is displayed in the Figure. The Cylinders are load conveying components in the framework, moves the powers between the info side and disengaged side. It likewise gives travel of the suspension. The Accumulators are the components which give the spring capacity through a versatile medium. For the most part the collectors are preloaded with gas, as gas is compressible and it gives expanding pressures expanding loads. The Flow Resistors (hole) are significant components for the framework as they give the required damping to retain the unsettling influences. The Hydraulic lines and fittings are the components which move mechanical power from one spot to other of the circuit in type of water driven/pneumatic energy. They additionally go about as controlling gadgets. The main thing of this framework is the gas chamber, consequently the firmness will be characterized, essentially, by the volume and tension of the gas. In certain vehicles that utilization hydro-pneumatic suspensions, the chamber is worked from two sections, that joined, take the shape of a circle, and the gas is isolated from the water driven liquid by an adaptable stomach, as Yohsuke (1999). This stomach evades gas releases in any event, having water driven liquid misfortunes, on the off chance that the framework isn't fixed flawlessly. The water powered liquid depleted of the framework streams to a repository and return to the framework using a pressure driven siphon, keeping the vehicle level steady. A semi-dynamic control can be finished through a flexible valve that increments or diminishes the damping, accomplishing an improved framework. A functioning suspension may be accomplished by the control of the water driven liquid volume, changing the vehicle level. This arrangement adaptability is one of the most remarkable benefits of hydro pneumatic suspension frameworks The model is approved by estimation information on both part level as well as full vehicle level. The model can be utilized for additional research as for alive damping control or executing the framework in different vehicles. As the vehicle is planned without wheel suspension, wheel loader drivers are presented to elevated degrees of entire body vibration which impacts ride solace adversely. The work
introduced in this proposition has the mean to examine the potential in adding a hub suspension to a wheel loader to diminish vibrations what's more, increment taking care of value. Of extraordinary importance fostered a suspension which isn't just fulfilled the soundness and traveler solace yet

additionally understood smaller space limitations. The hydro-pneumatic suspension framework with its prevalent non-straight attributes what's more, superb vibration decrease execution fulfills the necessity of the designing huge weight vehicle ride solace, and further develops the riding solace of vehicles to the greatest.



2.Operating Principle

The hydraulic pressure should be adjusted for the static loads to a required level by adding or releasing the hydraulic fluid from the accumulator. As the piston moves towards the piston side due to the static load, the fluid volume in the accumulator changes and hence the pressure also changes. Gas, which is the other fluid in the accumulator, gets compressed and exerts a force on the piston rod. This defines the spring rate of the system. The force acting on piston is always equal to the forces resulting from the pressures acting. When the force is increased due to the road profile, and the piston is displaced by a distance "x", the hydraulic fluid is displaced into the accumulator which changes the pressure. This change proceeds until the pressure in the accumulator has reached a certain level which again provides a balance for the system. The damping effect can be calculated using Stiffness as a parameter given by $C=(Fs-Fd)/x$

Where, Fs – initial static force Fd – Dynamic load x – Displacement To allow for additional damping, a flow resistor is placed between cylinder and accumulator. It converts the kinetic energy of the hydraulic fluid into heat and thus providing the damping effect. The damping of the system happens in combination with the boundary friction between the cylinder sealing and guiding elements and the viscous friction within the fluid. The typical combination of mechanical spring and damper unit can be replaced by this system consisting of cylinder, accumulator, flow resistor and hydraulic fluid. One more advantage of using Hydropneumatics suspension system is level control. By adding an additional level control unit, a constant position can be maintained independent of the static spring load. It is assumed that leakages in the cylinder are negligible (due to the tightly sealing piston), the compression of the cylinder causes a flow out of the piston. The flow rate depends on the piston area Apand the rate of compression.By combining the flow through the pump Qm with the flow in the cylinder we get the velocity of flow going towards the accumulator. $\dot{Z}$ going towards the accumulator. In order to make a linearized model of the system, it is important to estimate some of the most nonlinear parameters with simpler versions. These parameters include the Orifice damping values C0 and the friction torque Tv of the pump. The damping values of orifice is highly nonlinear since it depends on both the amount of flow going through the valve and the user defined suspension stiffness.

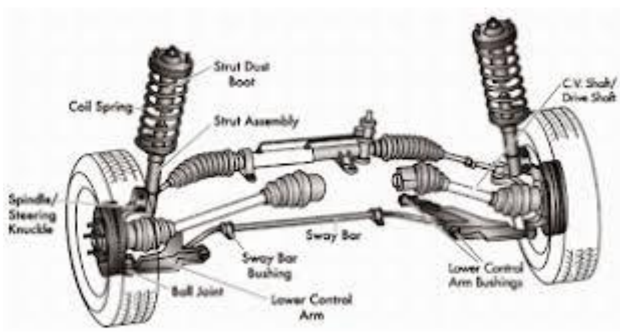
3.Hydro-pneumatic suspension system

Hydropneumatic suspension is a type of motor vehicle suspension system, designed by Paul Magès, invented by Citroën, and fitted to Citroën cars, as well as being used under licence by other car manufacturers, notably Rolls-Royce (Silver Shadow), Maserati (Quattroporte II) and Peugeot. It was also used on Berliet trucks and has more recently been used on Mercedes-Benz cars. Similar systems are also used on some military vehicles. The suspension was referred to as oleo pneumatique in early literature, pointing to oil and air as its main components. flow towards the rear of the bot. the scrubber is fixed to the chassis using clamps. The construction of the scrubber includes fixing one side to the motor and the other to the ball bearing. The bearing is clamped to the chassis. At the rear of the system a vacuum mechanism is used to suck the debris laden dirty water. This is also the same type of pump and the chamber.

4.Requirement for suspension system

Suspension frameworks have a wide scope of applications in our day to day routines. Normally individuals don't even realize that they exist, yet they are making a hard showing in a large number cases. Assuming they breakdown it is in many cases the initial occasion when one begins contemplating them. For instance, anyone who has ridden a bike with too low tire tension will presumably recall how delicate and unbalanced the bicycle felt on smooth

streets and how seriously he felt the knocks when there was even the smallest lopsidedness. A ride conduct which is hazardous what's more, awkward. For this situation the spring pace of the suspension framework (for example the tire) was excessively low and the accessible suspension travel was excessively little. Hence the suspension arrived at the restriction of its stroke and ran vigorously into the end stop - edge and street surface with the elastic of the in the middle between. Then again, a too high tire pressure and an appropriately too high spring rate can likewise lead to distress on the bicycle. Without adequate tire versatility the unpleasantness of the street is moved straightforwardly into the bicycle outline and moreover into the rider. This again adversely affects the solace of the rider. It is clear that finding a reasonable degree of tire is vital strain and in this manner spring rate which fits specifically to the weight of the rider.



5.Applications

1)a level control is needed in particular for level readjustments after major load changes

2) a level control needs to work frequently and needs to react quickly

3) a manual operator control for the suspension level is desired

4) little space is available for suspension elements

5) possibly hydraulic cylinders are already available for control of the desired suspension degree of freedom

6) robust components are required due to the harsh working environment

7) a lockout of the suspension in the design position is required

8) the spring rate needs to be adjustable,

9) a hydraulic energy supply is already available.

6.Advantages

Hydropneumatics have a number of natural advantages over steel springs that are poorly understood, leading to general public perception that hydropneumatics are merely "good for comfort". They actually also have great advantages related to car handling and control efficiency, solving a number of problems inherent with using steel springs that suspension designers have always dreamt they could eliminate. Hydropneumatic is naturally a progressive spring-rate suspension; i.e., the more it is compressed, the harder it becomes. This results in the suspension being extremely soft around its initial course (softer than a steel spring) but getting harder and harder as compressed (more than a steel spring). This is because of the properties of gas: halve its volume, and its pressure doubles. When the suspension operates, the ram is pushing oil into the sphere altering its gas volume (and therefore the pressure). This natural principle of hydropneumatics has not been met so far by any other type of suspension. The nearest is steel springs with a softer course and a harder course (two different spring rates, while hydropneumatics offer an infinite number of rates). Usually steel-sprung cars are either too soft ("comfortable"), or too stiff ("sporty"), or some intermediate compromise, while hydropneumatics offer "two cars in one"

. 1) This advantage pays off in a spectacular way when slaloming (otherwise known as the 'moose test'): the swinging speeds and acceleration patterns of the body of a hydropneumatic car offer ideal body control, and "load" the tyres in an ideal linear-like manner, helping to get the most out of them. A steel-sprung car acts more like a violently-swinging pendulum, "crashing" on its tyres (and abusing them) when leaning from side to side.

2) The same natural law governing gases also ensures that the suspension's spring-rate (hardness) is continuously adapted to the weight it has to carry, and to infinite positions. For example, when the car is standing empty, the pressure within its spheres is in balance. If one passenger enters the car, this pressure becomes higher by the value of his weight (the gas in the spheres compressed to an equal degree, i.e. has now become "harder"). The car will have lost some height, so the self-leveling system immediately reacts and brings the car up to the predetermined ride height. The result is that the spring rate is kept constant, regardless of the load of the car. I.e., a car with 4 passengers and full payload will be equally well controlled as a car with just one passenger (bar the tyres, which of course remain at the same pressure.). With a steel-spring car, either the car would be set up to be comfortable with 1-2 passengers but getting toosoft as more weight is added (becoming uncontrollable under full payload), or it would be too stiff with 1-2 passengers and okay on full payload.

3) This effect is especially pronounced at the rear axle, where the designer of a steel-sprung car has to make the greatest compromise: the rear suspension has to be able to deal satisfactorily with a large range of load. Because of the above property of hydropneumatics, Citroën vehicles can have a rear that is set very soft; one can easily push the empty car down with his hand. When load is added, it stiffens as much as necessary. Steel-sprung cars need to have rear springs much stiffer than necessary for average daily driving.

7.Disadvantages

Service sometimes requires a specifically trained mechanic, but can be done by any DIYer with knowledge of the system or the correct manual.

1)Hydro pneumatic suspension systems can be expensive to repair or replace, if poorly maintained or contaminated with incompatible fluids.

2) Failure of the hydraulic system will cause a drop in ride height and braking power will decrease. However, an acute failure will not lead to acute brake failure as the accumulator sphere holds enough reserve pressure to ensure safe braking far beyond that needed to bring a vehicle with a failed system to a standstill.

8.Conclusion

This work talks about with the attributes of hydro-pneumatic suspensions. A model for the nonlinear solidness is introduced, and furthermore a technique for the arrangement and plan of the chambers and basic parts. An investigation of the damping conduct is created, what's more, an exploratory confirmation of the anticipated way of behaving is introduced. A few investigations and integral examinations are being finished as of now.

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