ISSN NO: 2770-4491
Date of Publication:20-05-2022

Analysis of Tribocouples in Car Shock Absorbers and Hydro Cylinders

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Annotation: The article considered an analysis of existing methods for increasing durability (silent block and piston coupling of a shock absorber), as well as other vehicle suspension components. We substantiated the possibility of restoring the working capacity of the silent block and piston couplings of shock absorbers by replacing worn parts with an innovative repair kit, respectively, with conical and cylindrical spring inserts and developing a mathematical model.

Keywords: Shock Absorber, Passenger Car, Hydraulic Fluid, Cylinder, Piston, Hydraulic Shock Absorbers, Gas Hydraulic Shock Absorber Device Maintenance, Maintenance, Maintenance and Repairs, Internal Combustion Engine.

Structurally, the shock absorber consists of several main units, regardless of the type and design. The main element of the shock absorber of any passenger car is the working cylinder, assembled in a housing with ears for connection. It contains hydraulic fluid. And also in this cylinder is a piston, which is attached to the rod. The piston has special bypass valves for compression and return, sealing rings. They allow, when compressing the liquid in the cylinder due to the movement of the piston, to pump it into the free cavity of the cylinder.

The shock absorber is attached to the car body with a rod, and to the suspension through a silent block. To protect the internal cavity of the cylinder, and the rod itself, a protective cover or anther is installed on top of the shock absorbers. And in order to prevent the liquid from splashing out of the cylinder, a special cuff with a guide sleeve is installed in its upper part. These elements are included in both the simplest hydraulic shock absorber and in more complex designs. In addition to them, the shock absorber device may differ in a number of additional details[1,2].

As mentioned above, depending on the design, the device of shock absorbers can differ greatly. Consider the main classes of shock absorbers and their structural differences. First of all, shock absorbers are distinguished by architecture into one- and two-pipe

This shock absorber, in addition to the cylinder (flask), piston and rod, has another cylinder, in which the flask with liquid and the piston is hidden. During operation, the piston compresses the liquid, and it flows through the valve from below into the outer cylinder. There, additional air compression is created due to the incoming fluid. This is when the shock absorber is compressed, and when rebounding (when the piston rises in the flask), due to the opening of the valves on the piston itself, the liquid from the outer cylinder enters the flask again. This design of the shock absorber, despite its simplicity, has a number of significant drawbacks. Firstly, the flow of the working fluid occurs from one container to another through different valves at high air pressure in the upper part of the shock absorber[3,4]. This causes the so-called aeration phenomenon, when the liquid is partially mixed with air, which significantly reduces its properties. In addition, due to the use of a double case, such shock absorbers cool worse, which again negatively affects their performance and efficiency. Such shock absorbers cannot be installed with the stem down, as this will lead to their incorrect operation. Single tube dampers.

There is no external cylinder in single-tube shock absorbers, and the entire process of fluid flow occurs thanks to built-in valves directly on the piston. If, in addition to liquid, there is gas in the shock absorber, then it is also located in the upper part of the shock absorber body, separated from the liquid by an additional free-floating piston. Given the fact that this type of shock absorber does not have lower

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compression valves, the piston is a complex structure with built-in compression valves and rebound valves. Sometimes, along with the valves, special grooves and holes are machined. Such shock absorbers, due to better cooling, more effectively keep the car on the road.

In addition, due to the use of only one cylinder, with the same dimensions, a single-tube shock absorber has a larger volume in relation to a two-tube one, and this is also a significant plus. And due to the fact that the gas is separated from the oil by the piston, such shock absorbers can be installed with the rod both up and down[6,7]. This allows you to significantly reduce the unsprung weight of the car.

The first and most important is the vulnerability of such shock absorbers to mechanical damage. It only takes one dent on the body to make it necessary to change the shock absorber. Also, due to the high heat exchange rate, single-tube shock absorbers are subject to the influence of external temperature on their characteristics. At high temperatures, the gas pressure increases due to heating and, therefore, the suspension works harder, at negative temperatures, the opposite is true. However, to eliminate such negative phenomena, manufacturers often take out an additional gas and hydraulic chamber outside the shock absorber cylinder. This allows not only to eliminate the strong susceptibility of work depending on temperature, but also to increase the volume of gas and oil in the shock absorber without changing its dimensions. And also noticeably increase the working stroke of the rod[8].

For specific shock absorber settings, some manufacturers use special compression valves in the channels through which oil moves from the additional chamber to the shock absorber cylinder, similar in design to valves in two-tube shock absorbers. This allows you to significantly increase the efficiency of the shock absorbers, and also makes available a wide range of settings for such shock absorbers. The number of settings (modes of operation) can vary from one to 10. In this case, not only the stiffness changes, but also many other parameters: the stroke length of the rod, the speed of the piston, etc.

Hydraulic shock absorbers. In addition to structural architectural features, shock absorbers can also differ in filling - the type of working fluid. Until recently, hydraulic shock absorbers were the most common, where special oil was used as a filler. Recently, however, many leading manufacturers are switching to the production of gas-hydraulic shock absorbers. In addition to liquid, they also contain gas pumped under high pressure. Less common are shock absorbers where only gas is pumped inside. The gas pressure inside such shock absorbers can reach 60 atm[9].

The device of gas-hydraulic shock absorbers. Given the wide and widespread use of this type of shock absorbers, it is worth considering their main design features. The design of such shock absorbers is almost identical to conventional hydraulic shock absorbers. Except that the gas-hydraulic ones have special gaskets and cuffs that are able to keep gas inside the shock absorber at high pressure. Often, instead of air, inert gases are used in such shock absorbers, the most common being nitrogen. You should know that the larger the diameter of the shock absorber, the less pressure the gas is in it and, accordingly, vice versa. In addition, depending on whether it is a front or rear shock absorber, the pressure may also differ[10]. Design features of shock absorber struts (Fig.1.).

Shock absorbers can be installed separately from the springs, on the classic VAZ. And some are installed with a spring. It is a shock absorber inside and a spring outside connected by a special mount. And in this form, the rack is installed on the car. Depending on the model of the car, the spring on the shock absorber strut can play both an additional and a main role. In addition, very often the device of the shock absorber strut provides a special nut with which you can easily change the height of the strut and therefore change the clearance of the car.

Figure 1. External view of the shock absorber used for passenger cars

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Depending on the model of the car, shock absorbers as part of the suspension can be mounted in different ways. The most common mounting options are eye-to-eye, eye-to-pin, pin-to-pin. In addition to these mounting variations, there are also such mounting schemes: pin-crossbar, plug-in shock absorber.

The shock absorber is designed primarily to dampen vertical vibrations of the car body when driving on uneven road surfaces. When the vehicle is moving, vertical vibrations of the body may occur. This is not only movement along pits and potholes, but also maneuvering, especially at high speed [11]. During dynamic acceleration, a large load and weight of the body is shifted to the rear axle, thereby unloading the front wheels, which significantly reduces their adhesion to the road surface. In the case of emergency braking, the situation is radically opposite. When cornering at high speeds, the vehicle's weight also shifts to the outside of the corner, which also causes the vehicle's wheels to wobble on the road. And, in order to minimize this kind of load on different wheels, shock absorbers of various types and designs are used.

On the basis of theoretical and experimental studies, an urgent scientific problem has been solved, which consists in increasing the operational durability of vehicle suspension elements and reducing the cost of maintaining its performance by using innovative repair kits containing plain bearings with conical spring bushings in silent blocks and cylindrical spring bushings in piston mates.

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