

I. Galiev, V. Nekhayev, J. Saveljev

The Efficient Method of Locomotives' Vibro-protection, Based on the Spring Mechanical "Buckling" Systems

Omsk State Railway University
35, Marx Avenue, Omsk, 644046, Russia
e-mail: Saveljev@siboil.ru
URL: www.siboil.ru/Saveljev

Review: The spring mechanical "buckling" systems have been extensively used as additional rigidity damping factor in various suspension devices of moving objects.

In Omsk State University of Railway Engineers a great number of theoretical, laboratory and experimental research projects dealing with the use of such systems in locomotives' suspension systems and especially in locomotive driver's seat suspension gear have been carried out.

The results of these experiments have proved the great efficiency of these systems, for example, characteristics of the vertical locomotive vibroprotection have risen considerably up to 200 – 300 percent and for the driver's seat suspension these characteristics have not exceeded the ISO standards.

The theory of mechanics describes some resilient systems (fig.1) with the so-called "non-adjacent" balance form (or buckling systems"). Relation between impact and displacement in such systems is shown on fig.2.

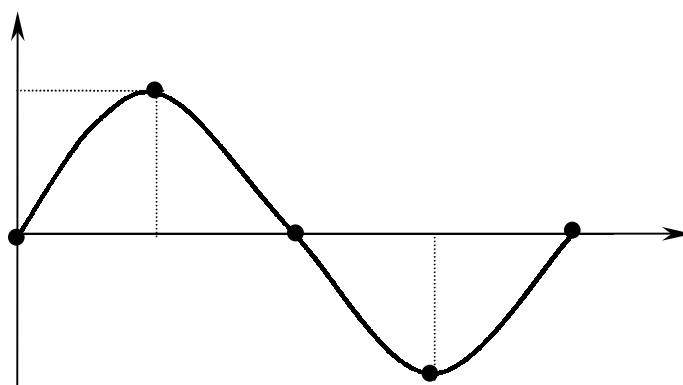
The fact that in some range of displacements there is a certain zone of negative hardness gave scientists an idea of using resilient mechanical "buckling" systems as an effecting way of vibro-protection of some dynamic objects (fig.3).

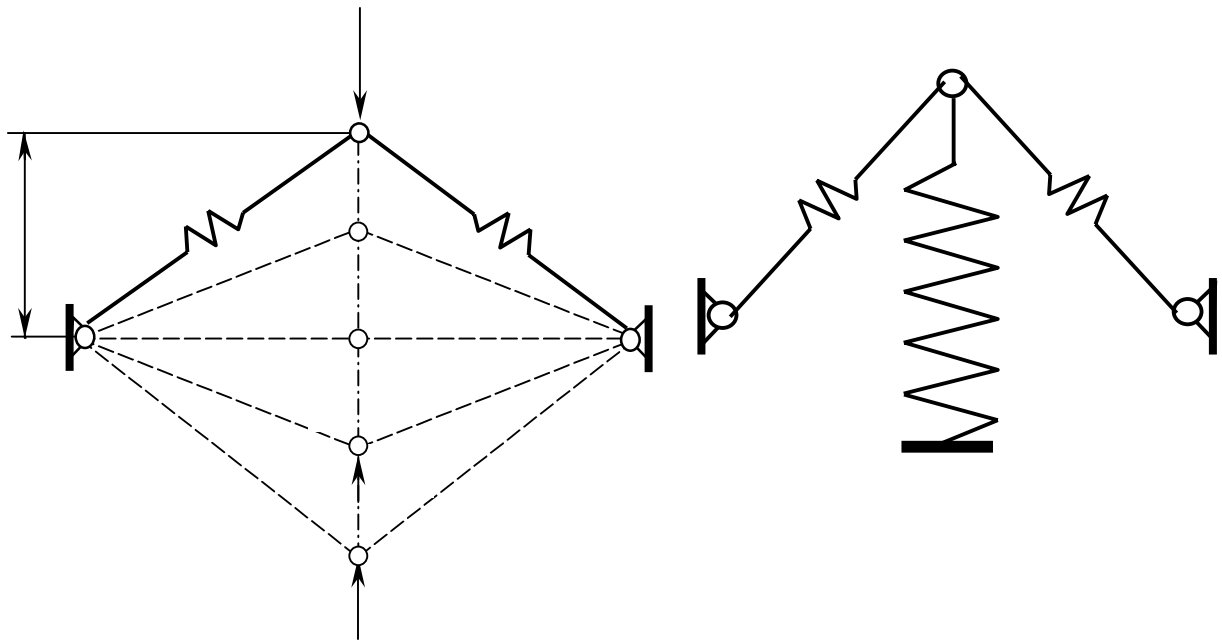
The Omsk State Railway University conducts research work which deals with the practical implementation of such systems in vibro-protection of rolling stock, locomotive is operators and so on.

As we know spring blade and spring suspension have linear characteristics have a whole range of useful properties such as easy production methods and simple maintenance reasonable reliability and so on. But with the higher speeds and higher harshness of railroads (especially in the severe climatic conditions of the Siberian, Northern and Far Eastern regions of Russia) those systems are not sufficiently effective.

The suspension system using the combined work of the resilient linear component (spring suspension) and "buckling" system has non-linear "progressive" characteristics and is very effecting when we want to get minimal values of hardness in the system is most widely used range without the main linear element is static displacement. Such a suspension allows to shift the resonance range of vasculations into the zone of small speeds. And besides when displacements increase (curve's movement) the hardness of the suspension also increases, which is important in case of lateral stability.

Thus we made the experimental vibro-protection system for locomotive VL-8.



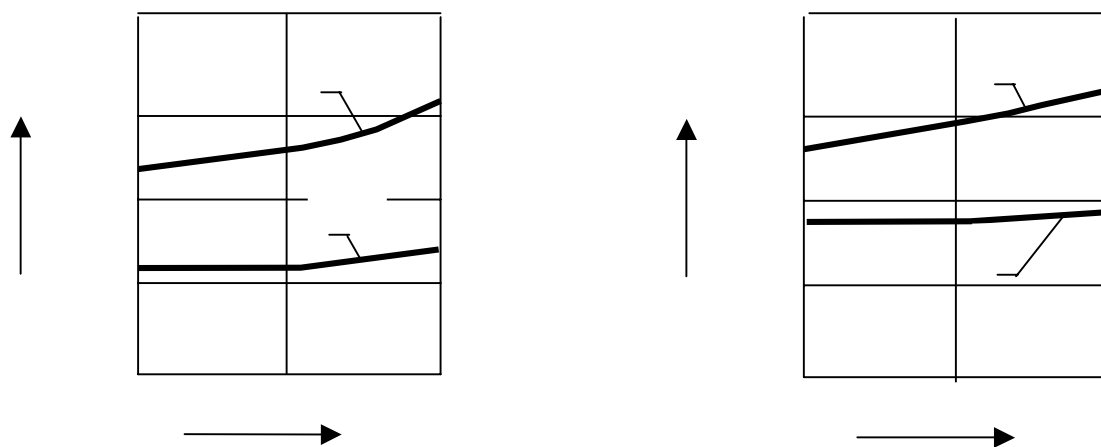


Our research shows that the vertical dynamic characteristics of locomotives have become much better but at the same time there appeared some negative factors, for example a considerable rebound force (about 40 tons), bigger suspension's size, bigger weight and soon.

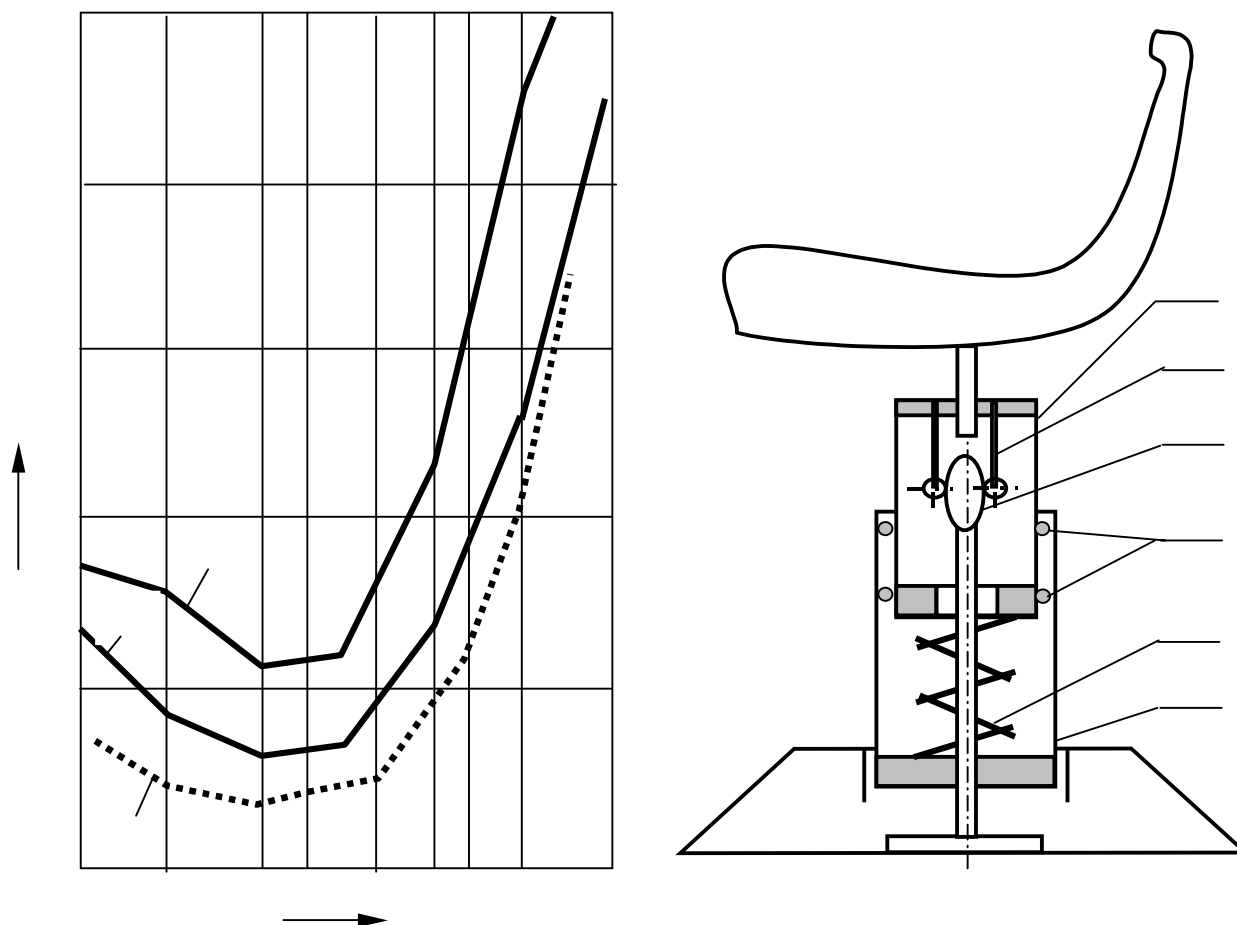
The laboratory, headed by professor Pachomov, made real-life experiments with the electric-power locomotive VL-10Y-019. This locomotive was equipped by the vibro-protection system developed by our University together with the ВЭЛНИИ.

The resonant "buckling systems" consist of the torsion shafts with the movable contact of the working device.

The fig 4 shows the results of these experiments, which give about 2 times less vibration levels with our vibro-protection system (1-with the vibro-protection system, 2-without the vibro-protection system).



Also we have been doing much research work on the locomotive's driver seat suspension, using the "buckling systems". The traditional vibro-protection system (spring and damping device) does not provide the necessary protection level of comfort (fig.5, curve 1) demanded by sanitary regulations SN 209-74. Curve 2 corresponds to the International Standards ISO 2631-74. Figure 5 (curve 3) gives root-mean-square values of vibro-impulses on the driver's seat.



On the meantime the driver's seat (patent № 1043048) has been in use since 1980 on locomotives VL-80.

But we suggest a new driver's seat (fig.6), which is simple in production methods and gives more effective vibro-protection.

The correcting system consists of the specially profiled cam 1, on the surface of which roll special rollers, which are fixed by resilient sticks 2. All these elements are dependant on the hardness of the main spring 3. To minimize the attrition between the outer cylinders 5 and inner cylinder 4 there are. Two rows of balls 6, placed in the separator.