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ANALYSIS OF THE DRIVE CONSTRUCTIONS OF EXTRA-LOW PRESSURE RUBBER-TIRED PROPELLERS OF THE VEHICLES FOR CARRYING GOODS

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Abstract

Overcoming of road impassibility, increase of vehicle passability are the issues that are always actual for the areas with insufficiently developed road network in remote regions of the North, the Far East, Siberia, and also the lack of roads in oil and gas production places and their transportation to gathering stations. This issue is also actual during rescue missions after natural disasters, emergency situations and technogeneous disasters. To solve this important issue domestic and foreign industries produced and produce different kinds of off-road vehicles and snow and swamp-going vehicles: caterpillar, ski-caterpillar, on low-pressure tires.

The advantage of the latter is the discovery of new opportunities in transportation, ecological compatibility, improved productivity and passableness. It is important to mention that almost all vehicles on extra-low pressure tires can swim. The fact that they all possess hermetic frame contributes to it, what is more, this usage of extra-low pressure tires provides this opportunity. This opportunity to deliver goods by the vehicles with extra-low pressure tires (VELPT), having no restriction in exploitation in summer and winter in the conditions of Arctic weak tundra, increases the competitive power of these vehicles compared to caterpillar off-road vehicles.

Moreover, their usage is much cheaper than delivery by helicopter. All these lead to the popularity of VELPT, the growth of the number of their types for various purposes and appearance of new producers of this type of off-road vehicles.

Keywords*: cross-country vehicles, extra-low pressure tires, vehicle passability, transmission of power, transmission*

Vehicles with extra-low pressure tires (VELPT) help to solve a problem of delivery of large-size goods and technological equipment to remote regions with the lack of roads [14, 16, 17]. VELPT for goods delivery, drawing an analogy with cross-country vehicles for goods delivery, can be referred to the vehicles with extra-low pressure tires with permittable all-weigh over 3500 kg, consequently, with the carrying capacity over 1500 kg. Particularly, appealing to the Governmental Regulation of the RF from 12.07.1999 No. 796 called "About confirmation of the rules for the permit to operate mobile machinery and issue of the certificates to tractor-engine drivers (tractor drivers)", this type of off-road vehicles belongs to the category of mobile machinery A III. This category of certificates gives the right to operate off-road vehicles with all-weigh over 3500 kg (with the exception of those relating to category "AIV").

VELPT for goods delivery, possessing high carrying capacity, is usually produced in the form of chassis with different superstructures, can be also produced as modifications in the form of a bolster-type tractor to tow different types of semitrailers.

The first VELPT for goods delivery was produced in 80-s of the XX c. It was the construction of Association "Arctictrans" named "Babymammoth" (Fig. 1) which, weighing 4500 kg, was able to transport 1500 kg of goods in bad conditions (snow, mud) and tow an extra-low pressure tires trailer with all-weigh 4500 kg. This construction evolving has undergone three stages of development and perfection [2, 4, 11, 13]. Using this example of the stages, we can monitor the process of perfecting the major element of the construction of VELPT for goods delivery, which is hinge-joined chassis. The chassis of "Babymammoth" consists of two parts, front and back, connected by a special rotary device called a hinge-joined unit (fig. 2) possessing several degrees of freedom.

Fig. 1. VELPT for goods delivery "Babymammoth"

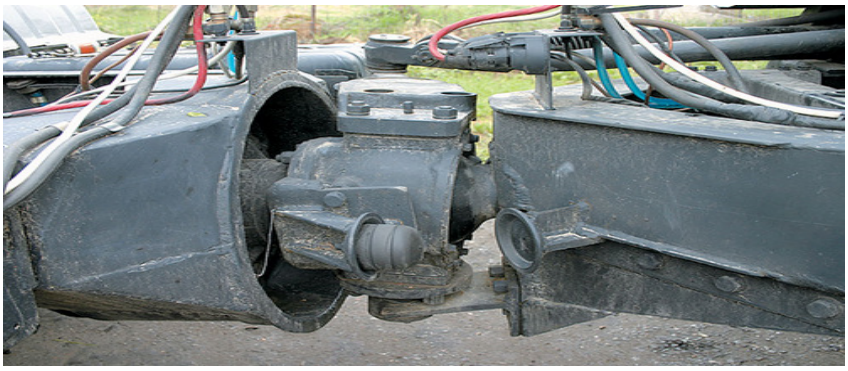

Fig. 2. A rotary-adhesion device of the hinge-joined chassis of "Babymammoth"

What is the purpose of using this complicated unit? Firstly, as it was mentioned previously [8, 9, 10, 12], while producing VELPT, the units which are part of batch-produced vehicles of off-road capability and also tractors, are used. "Babymammoth" is not an exception, the units of motorcar GAZ-66 (later its successor GAZ-3308 "Sadko") are used in its transmission, elements of suspension and frame. "Babymammoth" provides better cohesion with bearing ground.

The stages of the development of "Babymammoth" are connected with the improvement of a rotary-adhesion device. On the first stage from 1991 until 1998, it had a six-seated cab founded from two cabs of GAZ-66. Atmospheric Diesel engine Mercedes (capacity – 72-horse power) was put into a cross-country vehicle. Its rotary-adhesion device had three degrees of freedom: apart from "a break" of the frame horizontally and turning it in the shape of a screw, it could fold vertically what was an advantage in conquering the slopes [2, 4]. On the next stage, "Babymammoth" was engine with a more powerful Diesel unit D-243. As soon as it did not fit into the engine area of the cab of GAZ-66, they started to found to her a bonnet from GAZ-53. To improve the active safety (to avoid resonant step-up while moving along the hard surface roads) they started not to fold the frame vertically. To decrease deterioration of a rotary-adhesion device and also for fuel saving, a back axle was made with the option to switch it off [11, 13].

Secondly, what is most important, the usage of hinge-joined chassis allows to use the wheels with large diameter tyres, with low inner pressure (extra-low pressure tires) which provide towing qualities, high road clearance; to reduce the pressure on the ground under advanced load on the axis[1, 15]. The usage of these tires, with the number of dimension for "Babymammoth" in 1700x750 – 26.1 and using serial units, increases the width of VELPT and does not allow it to conduct maneuvers using the standard steering gear.

Besides, the usage of the "breaking" frame, as it was mentioned above, provides better wheels cohesion with the ground and reduces the load on the axis what in turn leads to the reduction of the dynamic load and, consequently, to providing a necessary resource of the units of the propeller and transmission [9].

Henceforth, the scheme of "Babymammoth" got its development in cross-country vehicles made by limited (liability) company "Omsk cross-country vehicles". This a series of VELPT for carrying goods named "Tungus", "Laptezhnik", "Muromec" with hinge-joined chassis, transmission which are made with the usage of modernized units serially produced lorries of cross-country capacity KAMAZ-43118, KAMAZ-65224. The restyling cabs from them are used as well.

These VELPT for carrying goods also inherited axle suspension from serial models. The chassis of cross-country vehicles "Tungus" and "Laptezhnik" have a wheel arrangement 6x6 and 12000 kg correspondingly. Chassis "Muromec" with a wheel arrangement 8x8 with a capacity in 15000-18000 kg [3, 5, 7].

The turning of the vehicle is done with the help of a rotary hinge connecting two half-frames (Fig. 3). A horizontally turning hinge (with two degrees of freedom) relatively to the vertical axis turns in 30 degrees in every direction and relatively to the horizontal axis; it turns in 15 degrees in every direction. Relatively to the vertical axis a cross-country vehicle turns. Relatively to the horizontal axis of the half-frame, it turns avoiding breaking loads and evenly redistributing them along all the axles of a vehicle, thus, reducing the dynamic load and increasing the reliability of the units of the driving gear. In "Muromec" the back (the forth) axle is also taxiing up.

Thus, VELPT for carrying goods with hinge-joined frames have a rotary-joined unit in their construction with the help of which, firstly, a turning with a relatively small radius (considering the size of the wheels 1800x1250x26 for "Laptezhnik" and "Muromec" and 1620x1050x24 for "Tungus") takes place; secondly, the contact mark and the grip of wheels increase in their size augmenting the cross-country ability; thirdly, the dynamic load on the elements of the clip and transmission decreases what leads to the increase of the reliability of the units of this type of VELPT.

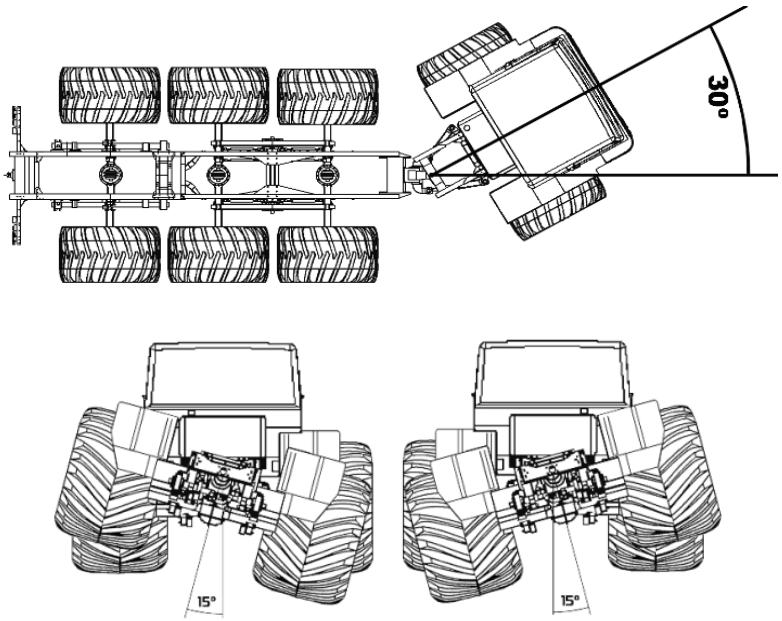

Fig. 3. A hinge-joined chassis of VELPT for carrying goods made by limited (liability) company "Omsk cross-country vehicles"

There are other constructions of VELPT, which are considered to carrying goods. This is, for example, a cross-country vehicle made by limited (liability) company "Avtoros" named "Shaman" and Z-83 with a wheel arrangement 8x8 with a capacity in 3900 and 4100 kg correspondingly and also capable of carrying 1000 kg. VELPT "Vektor" made by limited (liability) company "Polus-Vektor" possessing the same wheel arrangement as well as the previous models, and the laden mass 3000 kg. They have independent suspension, a complicated transmission, some units of the

latter are original [6, 8, 12]. However, the constructions of their car bodies do not allow having the same opportunities to transport goods as the above-discussed VELPT for carrying goods. Their construction peculiarities are typical for lighter models.

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