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TRENDING OF DESIGN DEVELOPMENT OF MULTIPURPOS LOGGING MACHINES

The work is devoted to trends in the development of domestic and foreign forestry machinery. The directions of improvement of structures specialized harvesters and forwarders. The evaluation of compliance with the technical parameters of multioperational technique "MTZ" and the world's leading machines manufacturers. Indicated promising areas of new and modernization of existing forest machines.

Introduction. Forestry enterprises of the Republic of Belarus are planning to increase volume of logging in final harvest to 5.7 mln. m³ by 2015 and to provide development of prescribed cut by 95%. On the whole, forestry enterprises plan to log wood in volume of 9 mln.m³ by 2015, and 70% of all wood will be logged using logging machinery.

For this purpose in 2011–2015 there have been planned to purchase 84 harvesters for final harvest, 121 for clear cutting, 410 forwarders and 180 log haulers for transporting timber.

One of the largest manufacturer of domestic logging machines is a public association "Minsk tractor plant" which can create a competitiveness to foreign manufacturers both on domestic market and in Russia. Nowadays, there is a production of separate models logging machinery for final harvest and clear cutting in our country. The next step in development of national machine-building will be in creation of efficient prototype of logging machine meeting the requirements of loggers and modern trends of development.

Main part. Today, in our republic assortment machine logging is widely spread. At forestry enterprises a share of assortment logging comprises about 85–90%, concern "Bellesbumprom" – about 80%. Felling-delimiting-buckers and loading machines produced by domestic plants have been started exploiting. However specifications of machines included in one system are not coordinated with each other. The use of felling-delimiting-bucker MLH-414 in the system of loading machine MLPT-354M1 is inefficient due to low load capacity of the latter. That's why the development of efficient felling-delimiting-buckers and loading machines is very promising trend in modern logging.

Productivity of transport loading machine depends greatly on engineering equipment fixed on it. Foreign producers pay much attention to correct selection and combination of arguments of manipulator parameters with those of basic machine as well as its rational location and ease of control. Manipulators applied in modern forwarders (depending on machine parameters and its operating conditions) have load moment from 85 till 145 kNm

and handling radius of 7.5–10 m. Specific feature of modern manipulator for forwarders is in application of a telescopic link on a handle that allows to extend its operating area. Manipulator drive is hydraulic, and feeding of manipulator elements and its propeller are supplied as a rule, from one hydraulic pump. Operating pressure of modern hydraulic systems fixed on forwarders ranges within 20–25MPa, and working volume of applied axial-plunger pumps is varied from 100 B4 190 cm³.

Power of motors of modern forwarders (depending on their own weigh) varies from 75 B4 180 kw, thus horsepower input per ton of transported load ranges within 7.2 kw /t for heavy duty machinery till 13 kw/t for vehicles with smaller load capacity (exception: Finnish forwarder "Ponsse Buffalo" having engine 205 kWt, specific power is 14.64 kWt/t).

Traveling conditions operating on logging constantly vary and is is very important to have a possibility to change (within a wide range) torque supplied to driving wheels. Its change can be executed both due to engine speed regulation, and due to change in transmission numbers. Motors of foreign forwarders have torque from 498 till 1,100 N·m, that allows them to move in hard operating conditions. However such high value of torque is seldom realized and results in significant incomplete use of power. Besides it actualizes the question of energy saturation parameters of forwarders applied in certain operating conditions.

Most of foreign forwarders are equipped with mechanic hydrostatic transmissions. Their hydraulic part is represented by hydraulic pump (axial-piston, as a rule) and hydraulic motor (both centrally-located and separate for each balance beam). Mechanical part of propeller is represented either by final drive or by driving axles and cardan gear. Changing modes is synchronized, by means of both effect on the motor, and hydraulic pump control. Use of such a mode of synchronized control allows forwarders to start and move without slipping in conditions with weak bearing capacity of soils.

Practically all foreign wheeled transport loading vehicles have load capacity from 9.3 t till 22.8 t with own weigh from 8.5t till 20t. Thus the more load capacity, the less own weight per tonne of transported load.

Ratio of load capacity to own weight for foreign vehicles with wheel formula 8X8 ranges within the limits from 0.70 to 1.03, and for vehicles 6K6 – from 0.71–1.07. For forwarders produced by “MTZ” this index varies from 0.70 till 0.82, that is less in comparison with foreign analogues. Therefore, it is reasonable to raise load capacity of domestic forwarders and to decline their laden mass due to option of rational parameters of bearing structures.

Considerable soil consolidation by wheels leads to formation of deep rut and to an increase of resistance to motion. Special forest tires are applied to drop specific pressure. To improve passability there have been applied anti-skid chains and flexible chain trucks that are installed on single axis and a balance bogie.

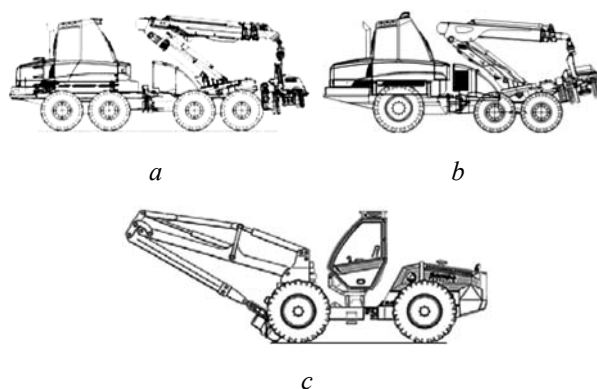
As transfer operations are principle in engineering working cycle of forwarders (unlike harvesters) manufacturers pay great attention to pressure reduction on soil. To achieve these purposes Finnish company “Ponsse” applied additional, separate, nonpowered, trailing axle on a service semiframe of the forwarder 10W. In such a structure specific pressure on soil is decreased due to a rise in bearing surface area of a forwarder. The greatest effect from such additional axle is attained by applying a removable flexible chain track.

Intensification of logging process according to assortment techniques requires transferring from manufacturing scheme of partial machine workpiece “a petrole – engine saw – forwarder” to more efficient one “harvester – forwarder”. Therefore it is reasonable to consider basic integration parameters and operational ability factors of felling-delimiting buckers (harvesters).

Production association “Minsk tractor plant” manufactures today 3 models of harvesters: MLH 1221, MLH-414 and MLH-424. Harvester MLH 1221 has a rigid semi-frame structure and is used for liberation felling. MLH-414 is based on a specialized biaxial articulated chassis and is used for thinning and severance felling. Harvester MLH-424 is built on three-axial articulated chassis and is effective in final harvest.

The major producers of harvesters are corporations: “Ponsse”, “John Deere”, “Valmet”, “HSM”, “Caterpillar”, “Logset”, etc. About 80% of all specialized harvesters have wheeled type of propeller. They are based on all-wheel drive chasses with wheel arrangement 4K4, 6K6 and 8K8 (Figure). Harvesters having chasses 4X4 and light types 8X8, as a rule, are applied for improvement felling

where low pressure on soil is of great importance. Chasses 6X6 and heavy types 8X8 are used for harvesters applied in final harvest. It is necessary to mark, that a number of large foreign enterprises manufacturing harvesters practically avoid using chasses 8X8 in vehicles for improvement felling. The main cause of it is low agility parameters of such vehicles owing to significant length of basic chasses. In operating conditions of improvement felling, where agility and ability to perform under forest canopy are the key factors, they are not competitive to more maneuverable and lighter harvesters 4X4.



Specialized harvesters with various wheel arrangements

Frames of wheeled harvesters consist of 2 units (energetic and technological) interconnected with hinge used for harvester turn. Hinge running is exercised by means of two hydraulic cylinders located on its sides. The angle of rotation comprises to $\pm(40-45)^\circ$. Harvesters 6K6 and 8K8 are equipped with balance bogies. They allow to overcome obstructions in the form of fallen trees, stumps and other irregularities occurred on logging sites and help to create more comfortable conditions for operator’s job.

Harvesters produced by “Caterpillar”, “ESO LOG” and harvester H8 by “Rottne” are equipped with running system with independent pendulous suspension of each wheel and each balance bogie with hydraulic control. This suspension ensures high passability in conditions of hard locality relief. Along with leveling of harvester both in longitudinal and cross-section plain pendulum motion can create a high ground clearance to 115 sm for overcoming single obstructions.

The drive gear of propeller of a wheeled harvester is exercised by means of mechanic, hydrodynamic and hydrostatic transmission. Mechanic and hydrodynamic transmissions being preferable in price, yields to them in a number of operating factors. Such transmissions have discrete ratios discrete change of torque.

The impossibility of smooth regulation of a torque on at low traveling speeds is a significant disadvantage of such transmissions as most of time harvester travels at speeds not exceeding 3 km/h. It actualizes a problem of using hydrostatic link allowing smooth regulation of travelling speed of harvester and it helps to change torque supplied to wheels. Such drive gear of propeller has, as a rule, 2 ranges of gear ratios which correspond to technological speeds from 0 till 8–10 km/h and transport ones from 0 till 18–27 km/h.

Conclusion. Analyzing the market of existing logging machinery of domestic and foreign production as well as loggers requirements to it we can conclude that domestic and imported transport loading vehicles with wheel arrangement 4K4 are in great demand with foreign and native consumers. Such machinery is still in demand even in spite of its production decline in the world. Such vehicles are more maneuverable due to smaller sizes and

larger semi-frame folding angles in comparison with forwarders 8K8 and 6K6, and they have better passability and lower price. One of disadvantages in existing forwarders 4K4 produced by “MTZ” is their small specific load capacity that results in decrease in productivity and consequently in efficiency of logging.

One of the ways of perfecting such kind of machinery lays in increase of its regular loading. However, changes of this parameter will lead to less passability, growth in fuel consumption, changes of forwarder towing properties and a rise of dynamic loads on its bearing structure. Therefore the factors having been analyzed require detailed study.

For further work being efficient, operating parameters of the designed transport-loading vehicle should correspond to perspective parameters of felling-delimiting-bucker.

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