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Technical Supply of Agricultural Machines

Abstract

The use of outdated technologies in the production of agricultural products causes significant losses in high amounts every year. Low labor productivity as a result of the application of outdated technologies in crop and animal husbandry and the low productivity of agricultural machinery reduces the competitiveness of local agricultural producers, does not allow for the creation of the necessary level of labor comfort and profitability in agriculture.

In addition, most of the agricultural machinery available in the country exceeds the specified wear periods and requires increased maintenance costs. In this regard, in recent years, high-precision agriculture and animal husbandry technologies have been intensively developed using computer science, electronics, automatic remote control systems and precision technology.

The article discusses high-yield-intelligent equipment designed for the application of resource-saving, environmentally friendly agricultural technologies in crop production. At the same time, due to the recent development of the production of machines with increased power and the creation of new modifications with smaller power differences, a variety of tractors has been explored.

Keywords:*agricultural production, fuel consumption, gearbox, tires, tractors, technology, engine*

Introduction

One of the most important conditions for the growth of agricultural production is machine-technological support of agricultural production.

World and local experience shows that the application of new high-efficiency resource-saving, high-precision technologies to agricultural production is only possible with high is possible on the basis of productive machinery and equipment (Alakbarov & Ismayilov, 2001).

As a result of the application of advanced technologies based on modern techniques to agricultural production, developed countries have achieved high indicators. Modern agricultural technologies are a complex of technological operations to manage the production process, achieving high productivity while ensuring environmental safety and certain economic efficiency. In modern conditions, effective development of agriculture is impossible without the transition to innovative technologies based on highly productive machines and equipment, called "Smart Agriculture" (Trubilin, 2010). Despite the achieved high technical indicators, foreign producers constantly improve the level of agricultural machinery.

Research

John Deere, Case-1H, New Holland, Deutz-Fahr, Valtra-companies use their own engines in their factories. In addition, they also use engines from different manufacturers in their tractors to expand the power range. Recently, thanks to the development of the production of machines with increased power and the creation of new modifications with smaller power differences, the range of tractors has expanded significantly. John Deere produces more than 39 models, New Holland − 65, Massey Ferguson − 56, Valtra − 31, Claas − 32, Deutz-Fahr − 31 models. Considering the high demand for their products in Southeast Asian countries, many tractor manufacturing companies organize production there (in China, India). Tractors are becoming mo re compact and maneuverable, and thanks to their modern design, they are even more advanced (Ismayilov, 2017)

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Many manufacturers offer tractors with a Powerboost power boost system. Numerous changes in the design of the engine and components made it possible to reduce the toxicity of exhaust gases. Tractors with power of 75-130 kW since 2007 - III class; Since 2008, 37-75 kW - Tier-IIIb, since 2011, for tractors with higher power class, and since 2014, it has been subject to higher standards. At the same time, the discharge of harmful substances should be reduced by 8 times, nitrogen oxides by about 2 times. The required indicators are obtained by using microparticle filters or selective catalytic reduction SCR (Selective-Catalytic Reduction) technology in engines.

Tractors with rapeseed oil engines are offered (Fendt, Deutz-Fahr, etc.). Also, the application of electronics is increasing, with the help of which all important functions of modern tractors are monitored and controlled. The innovation in tractors is the use of a high-power electrical network and the corresponding electric transmission of the cooler, air conditioner, compressor, water pump and electric transmission for external consumers (Tarasenko, 2002). The number of tractors with automatic transmission and continuously variable transmission is increasing and new models are appearing. At the same time, low-speed transmissions also appeared (Agroplus TTV-430 tractor manufactured by Deutz-Fahr up to 74 kW, Vario 312 tractor manufactured by Fendt company 81 kW) (Trubilin & Brusensov, 2019). Some tractors have a transport speed of up to 60 km/h. Like cars, they are equipped with anti-lock ABS brakes and use cruise control. Tractors of the upper power class are massively equipped with automatic parallel drive and program mable turning systems in a rotary lane (Fendt, John Deere, Case-1N, New Holland, etc.).

For tractors manufactured since 2007, the EU-2002/44/EC-directive has tightened the requirements on the level of vibration in the workplace. As a result, semi-active cabin suspension was introduced, the rear elastic elements of which automatically adapt to vibration changes during movement. (Claas and Valtra). For this purpose, the Claas company uses signals from three accelerometer transmitters installed in the cabin: speed, braking and steering angle. The damping process is controlled by changing the viscosity of the accelerating fluid (Claas) using a magnetic field or by electrically adjusting the cross-section of the accelerating hole (Valtra). The driver can adjust the acceleration by presetting the shifter to Acker (arable field), Straee (street) (Claas-firm) or manual control (Valtra tractor) (Trubilin & Brusensov, 2019).

ZF-group of companies offers new gearboxes. Thus, with the help of the usual renewal of the McCormick-X7- model- series, it was possible to create a completely new tractor. It is equipped with a ZF Transaxle T-7200 gearbox. The shift mechanism with synchronization device (ASS) requires no effort from the driver: proportional valves (PVS) ensure smooth, jerk-free shifting under all loads. X7 series tractors are produced in 143-212 horsepower.

Automatic PTO Switching − a new concept developed by Deutz-Fahr for continuously variable transmission tractors to automatically switch between nominal and "eco" PTO speed in order to reduce fuel consumption. It is a fully automatic system capable of making changes through interaction. Almost all companies offer an automatic gearbox on the market, which has elements of automatic selection depending on the engine speed and external load, can be reversed in work-only or all-gears, and changes gear without interrupting the flow of power. Some of them are also pre-programmed according to the load on the power take-off shaft, the position of the installed system or simply the duty cycle performed by the operator (Ismayilov, 2017). Involves changing the transmission according to the switching scheme. Some gearbox models allow you to select an economical operating mode when the tractor is partially loaded. According to some data, selecting this mode saves fuel by 18-22 %. The number of continuously variable transmission models is increasing. The Fendt company installs two-flow volume hydromechanical stepless transmission in the 400, 700, 800 and 900. Vario series with power from 63 to 269 kW-a. Their feature is a combination of mechanical and hydraulic gears (Figure 1) (Trubilin & Brusensov, 2019).

The division of power into mechanical and hydraulic-branches takes place in the planetary mechanism, and its combination is in the "collector" shaft. The power flow from the engine is transmitted through the torsional vibration damper to the planetary gear carrier, whose satellites rotate the ring and sun teeth. An external crown gear-wheel transmits rotation to an adjustable axial-piston hydraulic pump (the washer of this pump is stationary and the piston body changes the angle

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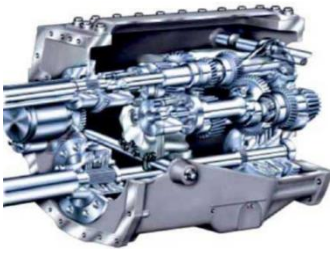
of rotation). The sun gear is connected to the rear wheels by two-stage teeth and a "collector" shaft. When the hydraulic motor is not working, the outer ring gear of the planetary mechanism is locked, then all the power flow from the motor is transmitted directly to the sun gear and the transmission is 100 % mechanical.

Figure 1
Stepless transmission



If the sun gear (and tractor wheels) is stopped, then the planetary gears (satellites) transmit power to the hydraulic pump via the crown gears. But at this moment, the pump is idle running, because the angle of rotation of the housing is zero, that is, no oil is supplied(Trubilin, 2008). The basis of the gearbox of the new New Holland tractors is the chain variator, which consists of a chain made of chromed steel. The chain moves between two discs of different diameters. Each chain-disc has a moving and a stationary conical surface. The gearbox allows you to change the speed continuously and without slipping in the range of 0.330 km/h. The sensors record the torque, as well as the frequency of rotation of the variator shaft and the engine, and transmit this information to the electronic control system of the gearbox.

When the angle of inclination of the hydraulic pump housing changes, oil is supplied to the hydraulic motors located at the two ends of the "collector" shaft. Locked hydraulic motors at the maximum angle of inclination of the bodies, transmit the power flow to the wheels through the shaft and the tractor starts to move (Trubilin & Brusensov, 2019).

The sun teeth, initially blocked by the stationary wheels, begin to rotate, and at the same time part of the power is mechanically transmitted to the wheels. As the pump continues to tilt to a maximum of 45°, the oil flow increases and the hydraulic motors rotate the "collector" shaft faster, increasing the speed of the tractor. At the same time, the sun teeth rotate faster and the mechanical transmission of energy flow increases accordingly.

Before the pump body reaches its position (45° at full capacity), the motor body starts to slowly change from 45° to 0°. When the body of the hydraulic motor is in the neutral position, all the motor power will be transmitted through the sun teeth, i.e. mechanically. This occurs because the crown teeth are blocked by the hydraulic pump, which cannot supply oil to the "neutral" hydraulic motors.

A stepless transmission with a mechanical two-speed gearbox, which can be changed only when the tractor is stopped, provides two ranges of driving speed: work 0-32 km/h and transport 0-50 km/h. Reverse movement is provided by changing the angle of inclination of the pump body in the opposite direction, which changes the direction of oil flow in the system.

The movement of the tractor is controlled by a joystick (multifunction control lever). It is moved forward to gain speed, and as the movement increases, the tractor accelerates, to move backward (moved backward). The degree of acceleration of the tractor (forward or reverse) can be changed using the switch located on the left side of the joystick, which has four positions. Turning the joystick to the left activates the reverse of the tractor, this time automatically, deceleration, stopping and acceleration in the other direction occur. The forward and reverse speed ratios can be programmed by the driver. This is time allows you to save, for example, it facilitates the execution of the movement during the turn. Moving the joystick to the right activates the cruise control unit,

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which maintains the set speed of the tractor. At this time, one of two operating modes is provided: maximum productivity or minimum fuel consumption (Runov, 2012).

On the right side of the tractor cab is the Variotronic automatic control system, which includes a joystick, a terminal and a control panel. This system is controlled by menu, buttons, key, engine support, transmission, power take-off shaft, differential locks and hydraulic valves.

The ZF Passau firm has launched the production of the newly developed Eccom 5.0 stepless transmission, which is designed for powerful tractors with a articulated frame (power up to 500 hp). The distinctive feature of this transmission is that it provides full power transmission in the economy modes, and the torque increases smoothly when the engine shaft rotation frequency is reduced.

The structure of the transmission was developed on the basis of technical documents that have proven themselves in the production of the ZF-Eccom model range. The power transmitted by the transmission is divided into two streams. Part of it is transmitted through an Eccom-type planetary gear, and the other part is transmitted through a reversible hydrostatic transmission (Pilnikova, 2012).

Design features include: an optimized gear range for reverse travel, a simple mechanism for connecting the front axle drive via a punched clutch, a custom-designed power shaft drive clutch with built-in brake, and a reinforced hydraulic pump drive for the drive and steering systems. Due to the dominance of transmission in tractors with a frame construction, power is transmitted from the engine to the axles through cardan shafts. The increased speed range of the transmission makes it possible to create a sufficiently large torque when starting work and ensures that the tractor moves at a speed of 50 km/h. When moving at a speed of 40 km/h, the engine shaft rotates at a reduced frequency. Electronic transmission the control system is installed directly in its housing.

Conclusion

In spite of the achieved high technical indicators, according to the level of agricultural equipment, producers are constantly improving in the following areas:

- creation of a wide range of high saturated energy equipment and production;
- adaptation (synchronization) of machine-tractor units;
- high precision execution of technological processes;
- lack of fuel consumption of engines;
- use of stepless transmissions;
- electronics, sensor systems, informatics, automation and wide application of robotics;
- application of electric transmission;
- implementation of environmental requirements – Euro − 4;
- ensuring the work is carried out at any time of the day.

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