Improvement of Operational and Repair Technology of Machine Design in Technical Service by Developing Innovative Constructive Technical Solutions

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Abstract. The increasing importance of technical maintenance (MOT) of tractors and cars (energy) is indicated by statistics not only from our country, but also data from other countries. At machine-building plants, 8 ... 12% of workers are engaged in maintenance and repair. Their number is growing day by day as a result of the high laboriousness of maintenance machines. For example, in the last ten years, the number of industrial workers has increased by 50%, and the number of people employed in maintenance and repairs has increased by 220%. Therefore, reducing the complexity of maintenance or its exclusion by developing the optimal technical design solution, given by us below, becomes relevant.

Keywords: Maintenance (service) of tractors, automobiles (power tools). Improving the adaptability of the design of energy facilities to technical (service) maintenance.

1. Introduction
In the last decade, the world has witnessed a rapid development of maintenance and machine repair, and in the future the development of this industry will accelerate. In Hungary, the costs of maintenance and repair - at the level of the national economy - amount to several tens of billions of forints per year, and the annual expenses for maintenance and repairs of agricultural tractors amount to 4 ... 5 billion forints. Therefore, reducing the complexity of maintenance (service) or its exclusion by developing optimal technical solutions, given by us below, becomes relevant. It is difficult to name a branch of the national economy in which the solution of the complex problems of mechanization and automation of agricultural production processes would not be associated with the use of chain, belt (flexible) gears and devices. The creation of a number of machines and mechanisms of tractors and automobiles was made possible thanks to the use of chain and belt drives in them, which have the necessary flexibility, noiselessness, work without vibration and slippage, and absorb light shocks and impacts. They can reliably operate in a wide range of transmitted powers from 0.1 kW to 5000 kW, up to 35 m / s speeds. The only drawback of chain and belt drives is that during their operation it lengthens and, as a result, its performance decreases. Therefore, it is necessary to carry out diagnostic work to check the tension of the flexible connection, and if a violation of the regulatory parameters of the tension is detected, perform maintenance to eliminate it.
2. Method
The research conducted in the field of operational manufacturability shows that systems with flexible communications in most cases are installed in those areas of the machine design in which it is not technologically and laborious to carry out operations for their diagnosis and maintenance. And, maintaining the regulatory parameters of tension is the basis for ensuring the reliable operation of machines.

3. Result and Discussion
Our studies have established that a relaxation of the belt tension by 20% leads to a slip of the latter along the working surface of the pulleys. At the same time, the temperature of the cooling system of the internal combustion engine (ICE) rises from 85 °C to 110 °C, the DC voltage generated by the ICE generator is reduced to 27%, the compressor performance by 30%. And, with increased tension, the resource of belt and chain gears is reduced to 40%.

Therefore, during the operation of the internal combustion engine, it is necessary to maintain the nominal values of the parameters of the flexible connections of the fan, compressor and generator by means of technical control at certain intervals of time.

According to GOST 20793-86, the frequency of the maintenance operation for “Checking and, if necessary, adjusting the tension of the drive belts” is 125 mot-hours, and the average laboriousness of carrying out it according to the data determined by us is 0.062 man-hours. From this it can be seen that for the maintenance cycle the laboriousness of carrying out only this operation is 12.85 people-hours. The exclusion of the operation of “Checking and, if necessary, adjusting the tension of the drive belts” from the structure of the maintenance of tractors and cars leads to a decrease in their downtime, and thus increases the productivity of the machine and tractor unit and car. we have developed an automatic device for tensioning belt and chain transmissions, used both on tractors and automobiles and on stationary power plants, which makes it possible to automate the working processes of their systems with flexible elements (Fig 1).

The developed automatic device, shown in the Fig, contains a housing 1 with a L-shaped channel 2, in the working shoulder 3 of which a rod 4 with a tensioning element 5 is placed, which provides a flexible connection 7 by means of a spring 6. The spring 6 of the rod 4 abuts against the adjusting nut 8, with which the plunger 10 is connected through the plunger 9.

The automatic device also contains a mechanism for fixing the rod 4, made in the form of rolling elements 11 located in the L-shaped channel 2 of the housing 1 and pressed against the rod 4 by a spring 12 and a return spring 13 located in the working arm 3 of the channel coaxially to the rod 4. The elastic force of the spring 13 is less than the elastic force of the spring of the rod 6, but more than the elastic force of the spring 12 of the rod fixing mechanism. The axis of the rolling body 11, located at the inflection point of the L-shaped channel of the housing 2, is located not higher than the axis of the working shoulder of the L-shaped channel of the housing 2, when the pusher 10 is removed from the channel of the housing, and above the axis of the working shoulder of this channel when the pusher 10 is inserted into the channel.
Automatic device for tensioning flexible elements (belt and chain gears) works as follows. Using the adjusting nut 8 and the spring 6, the tension element 5 connected to the rod 4, the device carries out the tension of the flexible connection 7 to the desired value of the deflection arrows (Fig 1). During operation, the branch of the flexible connection 7 is stretched, while the rod 4 with the tension element 5 under the action of the spring 6 moves and selects the slack. As the rod 4 moves, the rolling elements 11 under the action of the spring 12 advance in the L-shaped channel 2. In this case, the rolling body 11, located at the inflection point of the L-shaped channel 2 of the housing 1, is located with its axis not higher (on or below) the axis of the bodies rolling 11, lying in the working shoulder 3 of the L-shaped channel, thereby ensuring the fixation of the rod 4.

To change the flexible connection or carry out repair work and maintenance, the adjusting nut 8 is shifted back, releasing the spring 6. In the extreme position of the nut 8, the pusher 10 is moved upward by the action of the plunger 9, raising the axis of the rolling body 11 located at the inflection point of the L-shaped channel 2, higher than the axis of the rolling elements 11 located in the working arm 3 of the channel, and, which is the same, higher than the axis of the rod 4. This provides the possibility of the reverse movement of the rolling elements 11 and with them the rod 4 along the L-shaped channel 2 and 3 under the action return spring 13. Flexible connection 7 is released from the action of the tension element 5.

After completion of work, the device returns to its working position by moving the adjusting nut 8 to provide the necessary flexural flexure boom 7.

The developed automatic device allows for easy removability of belt and chain transmissions, increases the reliability of flexible elements, and also reduces the complexity of maintenance and repairs, improves the operational technological design of tractors and cars, while reducing the unproductive downtime of these energy tools.

And also, many years of research conducted by us show that the operational laboriousness of one technical (service) maintenance (MA) of the coarse fuel filter of diesel engines of machines is an
average of 462 s, and the coefficient of operational manufacturability of the design (ETC) is 0.17. At the same time, an average of 1.5 liters of fuel is used as a detergent to remove dirt and sludge.

If there are 30 tractors in the machine-tractor fleet, their unproductive downtime only when servicing these coarse filters is about four hours, and the consumption of diesel fuel for washing is 45 liters. Therefore, in order to eliminate the increase in the laboriousness of the technical service of machines, we developed a new design for the rough fuel filter for diesel engines (see Fig-2). The operational complexity of the proposed developed filter for rough cleaning of fuel for one maintenance is 59 s, the coefficient of operational manufacturability of the design is 0.95, and the consumption of diesel fuel for maintenance is 0.5 l.

The proposed device has a housing 1 and a glass 2. The device for cleaning the filter is made in the form of a scraper mechanism, which contains a valve 3 with a square shaft 4, tiered impellers 5, 6 and 7. Their edges 8, 9 and 10 are made congruent forming cleaned mesh surfaces the filter element 11, the damper 12 and the bottom of the glass 2. The element 11 is placed in the mandrel 13. The position of the damper 12 in the cup 2 is fixed in the annular groove 14 by the petals 15. The impellers 5, 6 and 7 are formed in the form of petals with a square hole center. Their edges are pressed against the mesh filter element 11, to the conical surface of the damper 12 and the bottom of the cup 2 by the springs 16 and 17. The stiffness of the first spring 16 is two times greater than that of the second spring 17. The end surfaces of the springs are supported on the impellers through shaped washers 18.

A threaded plug 19 is placed in the lower part of the cup 2, into which the valve 3 is screwed. The square shaft 4 ends with a groove on which the sleeve 20 is placed. The threadless cavity of the plug 19 is connected to the atmosphere through holes 21.

During the discharge of fuel sludge, removal of sludge and pollution with the handwheel 3, the valve is turned out of the screw plug 19. The impellers 5, 6 and 7 mounted on the shaft 4 clean the surfaces of the mesh 11, damper 12 and the bottom of the glass with their edges. Pollution and sludge go into suspension. With further rotation of the valve, the sleeve 20 together with the groove of the drive shaft 4 lowers into the threadless space of the fuel. Together with the latter, contaminants are discharged through openings 21 into a container for collecting spent fuel. The amount of discharge is equal to the volume of the glass 2.

![Fig 2. The proposed device for cleaning filters diesel engine machines.](image-url)
4. Conclusion
Thus, the proposed constructive technical solutions make it possible to increase the operational and repair manufacturability of the design of the machines, and also sharply reduces the complexity of the service, respectively reducing material and financial resources.

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