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Classification of "val" type parts of agricultural equipment for selecting the method of their restoration

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ABSTRACT: Parts of the "shaft" type are present in any mechanism and play an important role in ensuring the functional performance of components and assemblies. During operation, the shafts are subjected to operational loads, as a result of which defects may arise, the main of which are given in the article.

KEY WORDS: Shaft type parts, crankshaft, defect, wear, resource, hardness, roughness.

I.INTRODUCTION

It is known that tractors, cars and other agricultural machines are made up of many parts.They can be distinguished from each other by shapes, sizes, materials, reliability and other indicators.During the operation of these machines and mechanisms, their parts gradually lose their original properties and they have various defects. These defects are revealed during the maintenance and repair of machines. The main reason for the appearance of machine defects is the wear of the working surfaces of parts during their friction.If the machine loses its working condition due to defects, they are repaired.

Spare parts account for about 70% of the cost of repairs machines.The main source of reducing the consumption of spare parts in the repair of machines is the restoration of worn-out parts.Since the cost of restoring parts is 50-60% of the cost of their manufacture, increasing the volume of restoring parts is a real way to reduce the cost of repairing machines.

Practice shows that 85% of the parts to be rejected have wear of 0.1–0.3 mm in diameter, which means a loss of less than 0.5–1% of the mass of the parts.

Thus, a significant reserve for reducing the cost of repairing machines is the use of progressive methods of restoring worn parts.

There are a fairly large number of methods for restoring worn parts, each of which, to varying degrees, ensures the achievement of final results - not only to restore the nominal size, but also to increase the operational properties of the part.

Choosing a recovery method for a specific part requires knowledge of the capabilities, essence and technological features of existing recovery methods.

The geometric shape, dimensions and material of parts, the mechanical characteristics of the restored surfaces, the nature and magnitude of defects, the operating conditions of the part in conjunction (type of wear, nature of loads, aggressiveness of the environment, temperature regime, etc.), as well as the properties of the mechanical characteristics of the restored surfaces should be taken into account.For example, bond strength, hardness, wear resistance, fatigue

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Vol. 8, Issue 4 , April 2021

strength, machinability, etc. The determining factor is the productivity and technical and economic indicators of the restoration processes.

In connection with the above, the classification of the parts that make up the machine, according to design and technological indicators, allows you to develop technological processes for restoring standard and other parts, create technological equipment and devices for restoring parts similar in shape and size, rationally organize convenient workplaces and production.

II. LITERATURE SURVEY

Since ancient times, famous scientists of the world have been conducting research on the study of the laws of friction, wear and lubrication of machine parts and the development of measures against wear. Among them, for example, one can cite such scientists as R. Kieffer, P. Schwarzkopf, Kragelsky, M.M. Khrushchev, F.P. Bowden, B.I. Kostetsky, A.S. Pronikova, D.N. Garkunova, V.M. Sorokina, A.V. Chichinadze, U. A. Ikramov, K.Kh. Makhkamova and others.

It is known that when repairing agricultural and land reclamation machines, most of the costs are spare parts that are replaced instead of worn out parts. To reduce the cost of spare parts when repairing machines, the restoration of worn parts plays a significant role. In this regard, a number of methods have been developed for restoring machine parts. Such scientists as M. Spencer, D. Haynes, brothers Studdi, Dj. C. Teylor, M. M. Tenenbaum, V.N. Tkachov, A.I.Selivanov, V.I.Chernoivanov, E.L. Volovik, V. M. Kryazhkov, I. S. Levitsky, N. N. Dorozhkin, Yu. N. Petrov, I. E. Ulman and many others [5].

I.V.Kragelsky, M.N.Dobichin, and the work of the Komovs [6] it was said that the main reason for the failure of the machines was not a fracture, but an impulsive combination and the wears as a result of friction of the working organs.

D.N.Garkunov and the A.I.Polyakov's work [7] it is noted that "the main factor that leads to a decrease in the reliability of the aircraft and, as a result, a decrease in their service life is the wears of the details".

Professor M. M. Tenenbaum showed in his monograph: "The high tensile strength of the details is one of the necessary conditions for the reliable operation of the machines and the maximum economic efficiency of their use, because as a result of the wears, many (80...90%) moving elements and working bodies of the machines lose their workability."

It is known that parts of the "shaft" type come in two types: shafts and wasps.

The shaft is designed to support gear wheels, pulleys, sprockets and other machine parts placed on it, as well as to transmit torque.Some shafts (flexible, cardan, torsion) do not support rotating parts. During operation, the shaft undergoes bending and torsion, and sometimes additional tension and compression.

The axis is intended only to support the parts placed on it and is only subjected to bending.Unlike the shaft, the axle does not transmit torque. The axles can be fixed or rotating.

Shafts are straight, cranked and flexible in geometric shape.

By the shape of the section, they are distinguished: cylindrical shafts of solid section, cylindrical hollow, spline and with cut teeth.

By design, shafts are of constant diameter and stepped.

Shafts of constant diameter have increased strength due to the absence of stress concentrators. Stepped shafts are more common because provide more convenient assembly and fixation of parts.

Shafts, which, in addition to gear parts, carry the working bodies of the machine, are called main shafts.The main shaft of machines with a rotary movement of a tool or product is called a spindle. The shaft that distributes mechanical energy to individual working machines is called a transmission shaft. In some cases, the shafts are made as one piece with a cylindrical or bevel gear (pinion shaft) or with a worm (worm shaft).

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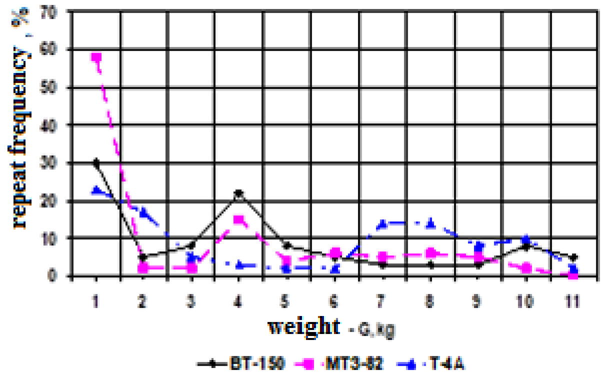
Vol. 8, Issue 4 , April 2021

Shaft and axle materials must be strong, work well and have a high modulus of elasticity.Straight shafts and axles are made mainly of carbon and alloy steels.Due to their complex shape and the action on them during operation of significant dynamic loads, crankshafts are often made of cast iron, because cast iron is lighter and cheaper than steel, has good casting properties and high damping ability.

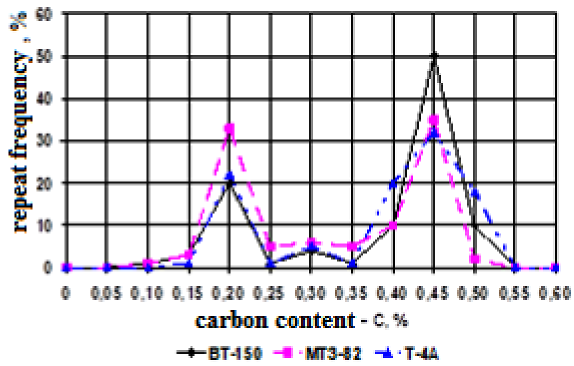
For shafts and axles without heat treatment, St5, St6 steels are used; for shafts with heat treatment - steel 45, 40X. High-speed shafts operating in sleeve bearings are made of steel 20, 20X, 12XH3A.The trunnion of these shafts are carburized to increase wear resistance.Shafts and axles are machined on lathes with subsequent grinding of the trunnion and seating surfaces.Parts to be restored are classified according to the signs of rotation and spatial shape: cylindrical external, cylindrical internal, threaded, spline, gear, flat, conical, spherical, shaped, etc.

III.BASED ON THE RESULTS

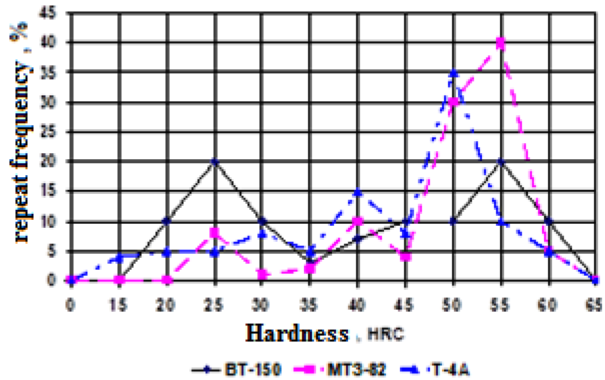
The analyzes of the masses, carbon content in the material, hardness, diameters, length and amount of wear of parts of assemblies and joints of three different brands of tractors showed the following results (Fig. 1).



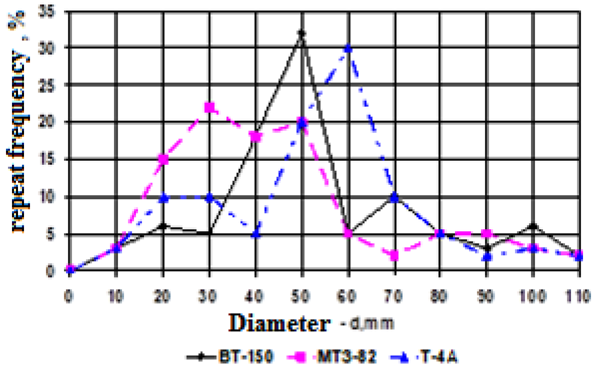
a) weight distribution of remanufactured parts



b) distribution of remanufactured parts by the amount of carbon in the material



v) distribution of remanufactured parts by metal hardness



g) distribution of remanufactured parts by their diameters

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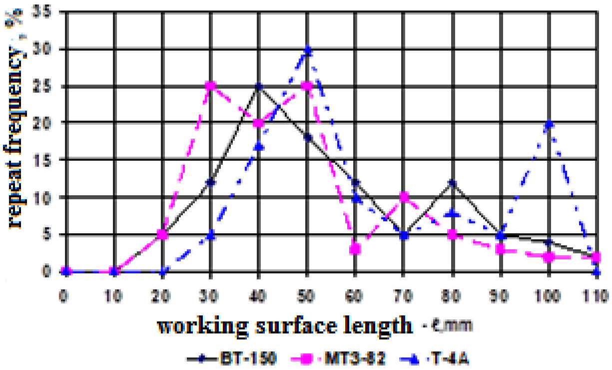
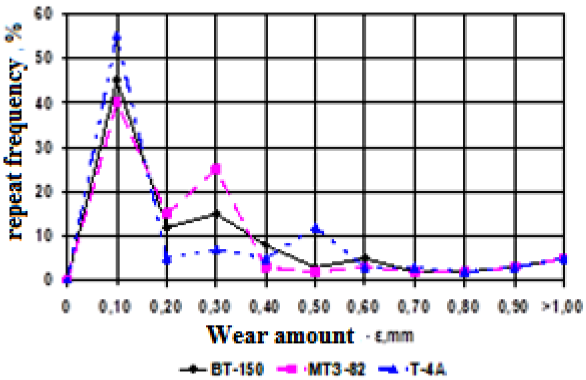
Vol. 8, Issue 4 , April 2021



d) distribution of recovered parts along the length of the working surface



e) distribution of remanufactured parts by the amount of wear

Fig. 1. Constructive and technological indicators of tractor parts to be restored.

In terms of the material of agricultural machinery parts, steel parts account for 79.9%, cast iron 18.5%, the rest of non-ferrous metals and plastics.

In recent years, new technological processes have been developed that make it possible to significantly increase the service life of machines and reduce the cost of repairing them.

Methods for restoring parts by type are distributed as follows: welding and surfacing - 70%, using repair dimensions - 12%, electrolytic coatings - 8%, polymeric materials - 6%, additional repair parts - 3%, plastic deformation - 1%.

To restore parts with slight wear (0.1–0.3 mm), new methods are used that give small allowances for subsequent processing: contact welding and sintering of a metal layer (metal tape, powder alloys, etc.), spraying with powder materials, plasma surfacing.

For the repair of parts with significant wear (1–10 mm), it is advisable to use electroslag surfacing and pouring with liquid metal.

The variety of methods for restoring worn parts allows you to eliminate the same defects in different ways, which affects the cost of restoration and the quality of the resulting coatings.

When choosing a restoration method, a number of factors should be taken into account that ensure the maximum resource of the restored part, the minimum cost of restoration, design features and dimensions of the part, the nature and amount of wear, the material and type of heat treatment of the part, the possible range of thickness of the applied coating, the productivity of the process, labor intensity and energy consumption of restoration, availability of equipment, damage to the environment.

Thus, the question of choosing a rational method for restoring parts should be considered taking into account technological, organizational, economic and environmental indicators.

The choice of a rational recovery method can be carried out in the following order.First, all methods of restoring a specific part are considered, taking into account the above indicators, clearly inappropriate ones are discarded.Having selected the methods applicable to the restoration of a given part, we establish which of the methods ensures the greatest durability of the part.Durability is numerically expressed by the coefficient of durability and is determined for each method of restoration and each specific part or group of parts.According to the criterion of durability, the method of restoration is determined, which provides the greatest resource of the restored part.

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Vol. 8, Issue 4 , April 2021

In the process of choosing a rational method of restoration, a technical and economic assessment of all compared methods is carried out on the basis of a technical and economic criterion, which reflects the dependence of durability on the cost of its restoration.

Technical and economic indicators of restoration methods

Restoring metods	Hardness coating, HRC	Thickness coverings per pass, mm	Performance, kg / h
Surfacing: electric arc automatic	14–63	0,1–20,0	1,8–60,0
under a layer of flux	17–62	0,5–20,0	1,8–60,0
flux-cored wires	21–60	2,5–3,0	2,0–20,0
in the CO_2 environment	20–62	0,8–4,0	1,56–4,4
vibroarc	14–63	0,5–5,0	0,6–4,4
plasma	32–72	0,1–12,0	2,0–18,0
induction	46–63	0,3–5,0	20,0
gas welding	13–42	0,5–1,5	1,41
electroslag	51–62	10–60	10–60
Electropulse	30–70	0,4–0,75	1,0
Electroplating: chrome plating	35–72	0,05–0,3	0,007–0,0248
ironing	21–62	0,1–3,0	0,011–0,085
Metallization: plasma arc	18–61	0,05–10	0,8–12
electric arc	20–42	0,10–3	2,5–38
high frequency	20	0,05–12	4,0–12
gas	43–48	0,05–12	0,8–20

When choosing a restoration method, it should be borne in mind that costs are reduced approximately in the following sequence: replacement of part of the parts, installation of an additional repair part, electrolytic build-up, welding and surfacing, restoration with polymer materials, pressure restoration, restoration to repair dimensions.

Comparative tests of various coatings make it possible to recommend the use of certain methods for the restoration of typical machine parts.

From the foregoing, the following conclusions can be drawn; today, many technological processes for the restoration of worn parts have been developed, which are the main reserve for reducing the cost of repairing agricultural machinery, which cannot be used when restoring all types of worn parts at once.

Therefore, the classification of machine parts by design and technological parameters makes it possible to develop standard and other types of technological processes for the restoration of worn parts, create universal technological equipment and devices for restoring parts of similar shape and size, rationally organize the production of machine belts and choose a technically and economically justified methods for restoring worn parts.

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