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Technological Features of Surfacing of Working Bodies Under a Layer of Flux

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Abstract: The service life of the working bodies of road construction equipment (bucket teeth of excavators and rippers) in the development of high-strength soils can be only a few hours. At the same time, the wear of working bodies made of high-alloy steels is 30-50%, and the rest is sent for scrap. In this situation, employers are forced to purchase expensive working bodies from foreign manufacturers. Therefore, in this situation, it becomes necessary to develop technology and equipment for the restoration of working bodies used in the repair of these machines, which will significantly reduce the operating costs of these enterprises.

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Introduction

An important factor in maintaining the operability and increasing the efficiency of using excavators is a high-quality and timely repair. Particularly difficult are the issues of restoring the working bodies of machines, the repair of which, due to their cumbersomeness and high metal consumption, is usually carried out in the field. One of the main types of repair work is surfacing of worn surfaces of bucket teeth, the quality of which determines the performance of excavator working bodies.

Currently, a large number of methods are known for restoring and hardening parts of the working bodies of construction, road, mining and other machines, the working bodies of which are subject to abrasive wear.

One of the effective methods of restoration and hardening of excavator bucket teeth with improved service characteristics is electric surfacing with wear-resistant alloys, a prominent place among which is electric arc surfacing under a layer of flux.

Description of the bucket design.

The bucket is the main working body of the excavator. Designed for digging, holding while moving and unloading soil or other material.

Depending on the purpose, excavators are equipped with different types of buckets. The most common are: Backhoe, Front Shovel, Grapple. An example is the design of a backhoe. The literature contains the following descriptions. The shovel is used to excavate the soil located below the supporting surface of the excavator. Backhoe bucket consists of a non-opening bottom body. The number of teeth on the front wall depends on the type of work and bucket width. The teeth are secured with cotter pins or bolts. The bucket is often a combination of cast and welded parts.

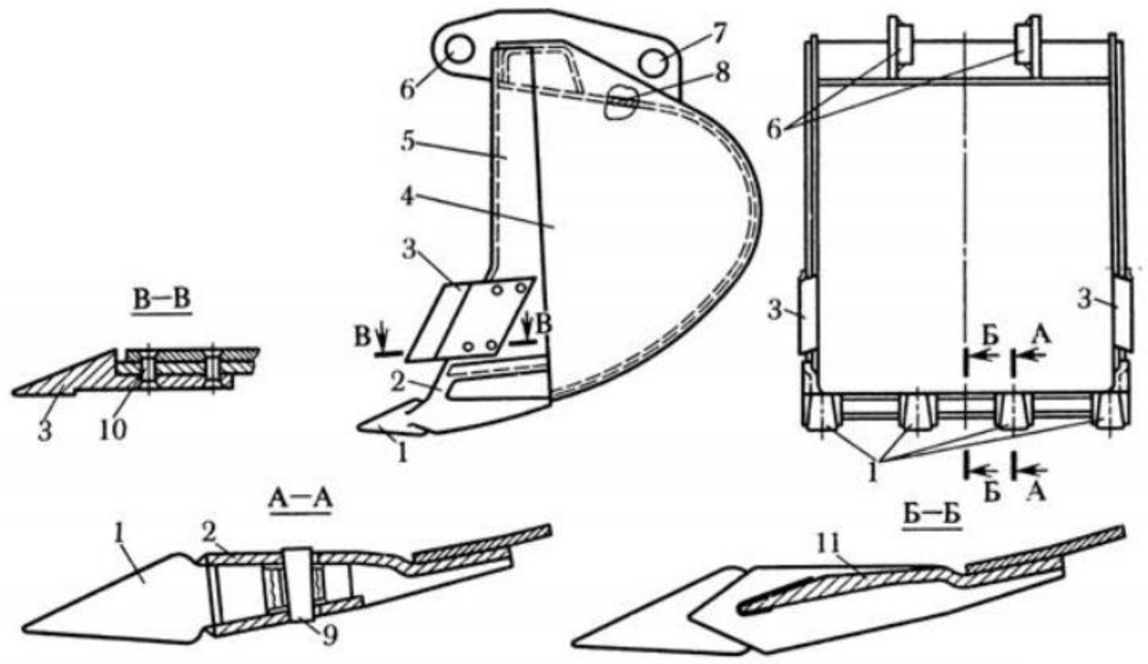

Figure 1 - Backhoe bucket for excavator EO-3322A

Operating conditions

The excavator bucket works in loose, cohesive, frozen and rocky soils. The particles contained in these soils subject the bucket to intense abrasive wear. The buckets are rejected by the presence of a change in the shape of the working surfaces as a result of wear.

The wear rate of the different parts of the bucket is not the same. The teeth and front walls are subject to the most intense wear. The service life of the front walls, depending on the operating conditions, ranges from 1 year (for the development of rocks) to 8 years (for the development of soft soils), the end part of the tooth, subject to the greatest wear - from several days to 6 - 7 months. The wear of the working body of the excavator worsens the quality of work, reduces labor productivity, and limits the resource of the machines.

Chemical composition and properties of steel 110G13L

Steel 110G13L is the main structural material for the manufacture of parts operating under conditions of abrasive wear with high loads and impacts.

The thermal conductivity of high-manganese steel is 3.5 times less than that of carbon steel. The thermal conductivity of steel is strongly influenced by temperature. When the temperature changes from 0 to 1000 ° C, the thermal conductivity coefficient changes from 0.031 to 0.061 Kcal / cm sec. ° C.

The coefficient of linear expansion is twice that of carbon steel and ranges from 18.0.106 to 23.1.10-6 (depending on temperature).

Scope and some properties of steel 110G13L

Hadfield steel was widely used in tank building. It was used to make tracked tracks for tanks. The first Hadfield steel for this purpose was used by the Vickers company from Britain at the end of the 20s of the 20th century. The use of this steel in the manufacture of tracks for tank tracks made it possible to significantly increase the mileage to 4800 km. By the way, before using the miracle - steel mileage was 500 km. Most interestingly, this small figure was considered a real record during the First World War. This fact shows how important the use of Hadfield steel was in the field of tank building.

Hadfield steel is used in many industries, as it has very important and useful qualities. When making products from this material, you can be sure that it will not let you down, since the strength and other positive qualities of Hadfield steel are undeniable.

High wear resistance and strength directly influenced the popularity of this material. Various enterprises engaged in the manufacture of different types of products used this material, since it was this steel that could provide the necessary strength of the product.

Steel has a low hardness, but at the same time it is endowed with unusually high wear resistance in friction under high pressure and shock conditions. This can be explained by the fact that Hadfield steel has an increased ability to work harden, which is significantly higher for this material than for steels with similar hardness.

Weldability assessment

During surfacing, a metallic bond is formed between the coating and the substrate, therefore the weldability of the materials is of particular importance. Welding and surfacing of 110G13L steel is fraught with significant difficulties.

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During welding and surfacing, significant changes in the base metal occur, especially in the heat-affected zone. As a result of these changes, a noticeable deterioration in the properties of the metal occurs in comparison with its original properties.

High-manganese steel has 4-6 times lower thermal conductivity and almost 2 times higher coefficient of linear expansion than carbon steel, which causes an unfavorable temperature distribution during surfacing. As a result of this temperature distribution, cracking, recrystallization and precipitation of carbides occur.

The austenitic weld structure is very sensitive to the cooling rate. Under real conditions of cooling of a part during surfacing, precipitation of carbides in the weld metal can be observed, hence a decrease in the stability of austenite and its decomposition with the formation of a ferrite-carbide mixture of high hardness.

Also one of the reasons for poor weldability is the high content of phosphorus, silicon and oxygen. These impurities form low-melting eutectics at the grain boundaries. Under the influence of the thermal cycle during surfacing, due to the eutectic, the strength of the grain boundaries decreases, and conditions for the formation of hot cracks appear. This phenomenon is exacerbated by the precipitation of carbides along the grain boundaries.

Technological features of surfacing

According to the literature, the most common methods used in hardening surfacing are:

a) manual arc welding with covered electrodes (SMAW);

b) flux-cored arc welding (FCAW);

c) submerged arc welding (SAW).

The application of a specific surfacing method depends on the conditions of the repair work.

Teeth working on rocky soils are welded along the wearing surface. Large debris will contact the tops of the weld beads without wearing out the base material. If soil gets between the rollers, the resistance to abrasive wear increases.

The multi-roll surfacing method reduces heat input and sensitivity to cracks. Surfacing must be carried out with alternating overlay of beads on individual elements of the restored tooth. The length of each roller should be 100 - 150 mm. During the surfacing process, the tooth should not heat up by more than 200 ° C

The electrode should be held to the surface at an angle of 70 - 80 ° and directed forward with narrow rollers without lateral vibrations. All craters must be carefully filled with metal and brought out to the ends of adjacent ridges.

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