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PNEUMODYNAMIC TREATMENT OF MACHINE PARTS BY MEANS OF SPECIAL TOOLS

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ABSTRACT

Pneumodynamic treatment of machine parts surfaces is performed by means of conventional metal cutting machine tools. The essence of the process is the fact that the balls acquire unfree movement under the action of compressed air, the movement being confined by the special tools. The ball trajectory is subject to the tool design and machining parameters. The roughness diminishing of the surface being processed as well as its strengthening is provided by the dynamic balls movement. The compressed air is admitted in by impulses.

KEY WORDS

Balls, compresed air, impulses, confined movement, special tools, trajectory is defined, metal cutting machine tools.

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Pneumodynamic treatment (PDT) is one of the latest and promising technologies of not only strengthening machine parts but at the same time diminishing surface roughness. PDT allows to increase efficiency of finishing operations simultaneously providing energy and material saving technology for machining plane, outer and inner rotating surfaces.

The PDT features which distinguish it from conventional shot-blasting treatment are:

- limited freedom of working bodies (balls) travel;
- periodic ingress of compressed air into the chamber;
- considerable size and mass of a ball (up to 15 mm);
- obligatory use of special tools;
- possibility of treating deep cavities inside a part, also inside deep holes;
- possibility to attain regular micro-relief of the part's surface being machined.

At the basis of PDT which has been invented by Dr.Sc., Prof. Minakov A.P. lies shocking, reiterating and short-time impact of the working bodies (balls) upon the surface being machined. The balls under the action of the compressed air acquire multi-axis rotation against their mass centre and move in the turbulent circling current of compressed air, which is in the state of adiabatic expansion at the outlet of pneumodynamic system chamber nozzle. Owing to PDT techniques there have been created technologies for pneumo-centrifugal strengthening treatment (PST), pneumo-centrifugal abrasive treatment, impulse-shocking treatment (IST), overlapping and combined treatment. These technologies are especially effective for machining non-stiff parts: long shafts, thin-walled sleeves of the internal combustion engines' cylinders, etc. [1]

It is considerably different from the conventional rolling by the fact that the elements causing deformation act on the surface being treated in the medium of compressed air in the conditions of changing energy of progressive and rotational movements with the angle velocities by an order of magnitude greater than with the stiff roller. The absence of the stiff kinematic link between deforming elements, mechanism of their drive and the surface being treated provide the possibility if high-efficiency treatment of cylindrical, conic, spherical, elliptic, and wave-like surfaces and planes.

The employment of PDT techniques are especially effective for dry and semi-dry friction couples, e.g. for connecting rods and sleeves of ICE cylinders, bearings, etc. PDT processes are precisely suited for non-stiff parts treatment because of lack of stiff links between deforming elements drive and the surface being processed. [2]

Further advantages of PDT are the ability to obtain regular and non-regular relief, microdents, and oil pockets on the surface, lack of necessity of the precise axis alignment of the tool and the workpiece, as well as the workpiece rotation.

The balls in the instruments for the pneumo-centrifugal treatment move freely along the circular groove, a special casing preventing them from dropping out. The compressed air comes into the expansion chamber through tangial ports, making the balls more around the tool axis with the speed of 4000-25000 rev/min. The balls roll by their periphery against the part being machined, making impact on it by means of centrifugal force. Apart from rotational movement the balls perform oscillating axis and radial movement due tot he compressed air income by portions. According to this technology a tool has an axis movement and the part being machined may rotate in any direction or other be immobile. Plastic strain of microroughness is secured by means of centrifugal force.

The tools for impulse-shocking treatment have two kinds of balls: block-head balls of small diameter and working balls. The block-head balls are kept inside by casing, but they come into contact with the surface being processed by means of their periphery. When the working balls rotate under the impact of compressed air impulses around the tool axis they collide periodically against the block-head balls which transmit these collisions on the surface being processes which provide microrelief in the form of depressions network.

The block-head balls acquire also circular movement although with the less speed which allow to machine holes, e.g. in the housing parts.

The balls in the tools for machining non-stiff shafts cause soft impact on the part being machined as opposed to stiff rollers.

The tools for finishing-strengthening treatment use special indentors as deforming elements, the working part of which being conical. The indentors are actuated by the working balls in an impulse manner under the action of compressed air. Being different from the previous tools this one can provide a deeper strengthened layer as well as regular and non-regular relief. Indentors can be produced from the hard alloy.

Combined treatment by means of PDT technology can be applied in combination with electro-sparking alloying. One or several deforming elements in the tools for such kind of treatment are set in such a way so as to be switched on to the impulse current source, the indentors material can be transformed on the workpiece being machined. This technology makes possible to machine parts made of very hard materials.

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