TOOLS WITH INTERRUPTED OR UNINTERRUPTED ACTION IN PROCESSING OF HOLES THROUGH (SPD) BY SCHEME WITH RADIAL FEED

Veselin Ivanov Grigorov

University of Ruse "Angel Kanchev", Bulgaria, e-mail: vgrigorov@uni-ruse.bg

Abstract: *The characteristics of schemes for machining of holes by surface plastic deformation in the implementation of interrupted or continuous action of the tools combined static or dynamic applying of technological impact are analyzed. Structures of tools that reflect the final version of the area of features that are determined by the interrupted or continuous of processing are proposed*.

Keywords: *surface plastic deformation, tools with radial feed, deformation rollersq*

1. Introduction

The main scheme characteristics of the processing holes by surface plastic deformation (SPD) are related to the realization of axial or radial feed and to the nature of technological impacts. The last of these characteristics is associated with the time of contact between the deformation rollers and treated surface. If the duration of the contact does not match with the operating cycle, the processing is with interrupted action of the tool, and depending on time of interaction between two successive interruptions of contact the deformation effect is a percussion (dynamic) or static nature.

In many cases the technology practice is substantiated [1] the use of scheme solutions with radial feeding of the deforming elements and for this purpose cone [2] or cylindrical [3] rolls are used. In the first case, the radial feeding is once at the beginning of the operating cycle, and the second - periodically in any interrupt of the operation of the instrument. The static application of technological impact is determined by rolling of the deforming rolls over a supporting cone or cylinder, and the dynamic - when using the cam shaft [4] or impact rollers [5].

2. Exposure

Using deformable cylindrical rollers is more favorable option for SPD, because through them avoids typical for tapered rollers disadvantages associated with the emergence of cinematic slip conditioned to unequal quantitative expression along the contact between deformable element and treated surfaces. The use of a support cylinder with interrupted surface or cam shaft shows deficiencies, associated with loss of productivity and the appearance of transitional stages, by means of superimposition of contact areas relevant to the non-Identity of the technological impact in the re-realization during the working cycle the tool.

In view of the above mentioned circumstances original designs tools deformable cylindrical rollers are developed. They realize a single feeding and radially uninterrupted or the interrupted action has percussion character. Through these structures the final versions of the scope of features that are determined by the continuity or discontinuity of processing, are presented.

Figure 1 shows the design of a tool with compound supporting surface that works with a single radial feed. It is performed by the interaction of extruders, located in the grooves of bearing sleeve 4, with the support shaft 2 and 3 deformation rolls, which are located in the slots of the separator 5 – fig. 2. Radial displacement of the rollers at the beginning of the operating cycle is achieved by a single relative rotation of certain angle between the shaft 2 and the bearing sleeve 4. During the deformation impact through its work surface extruders supplement the integrity of the outer cylindrical surface of the bearing sleeve 4, over which is deformation roll rolls. In the period of introduction and output of the tool from treated hole, through corresponding synchronizing devices are provided such angular position of the support shaft 2, the sleeve 4 and the separator 5, in which

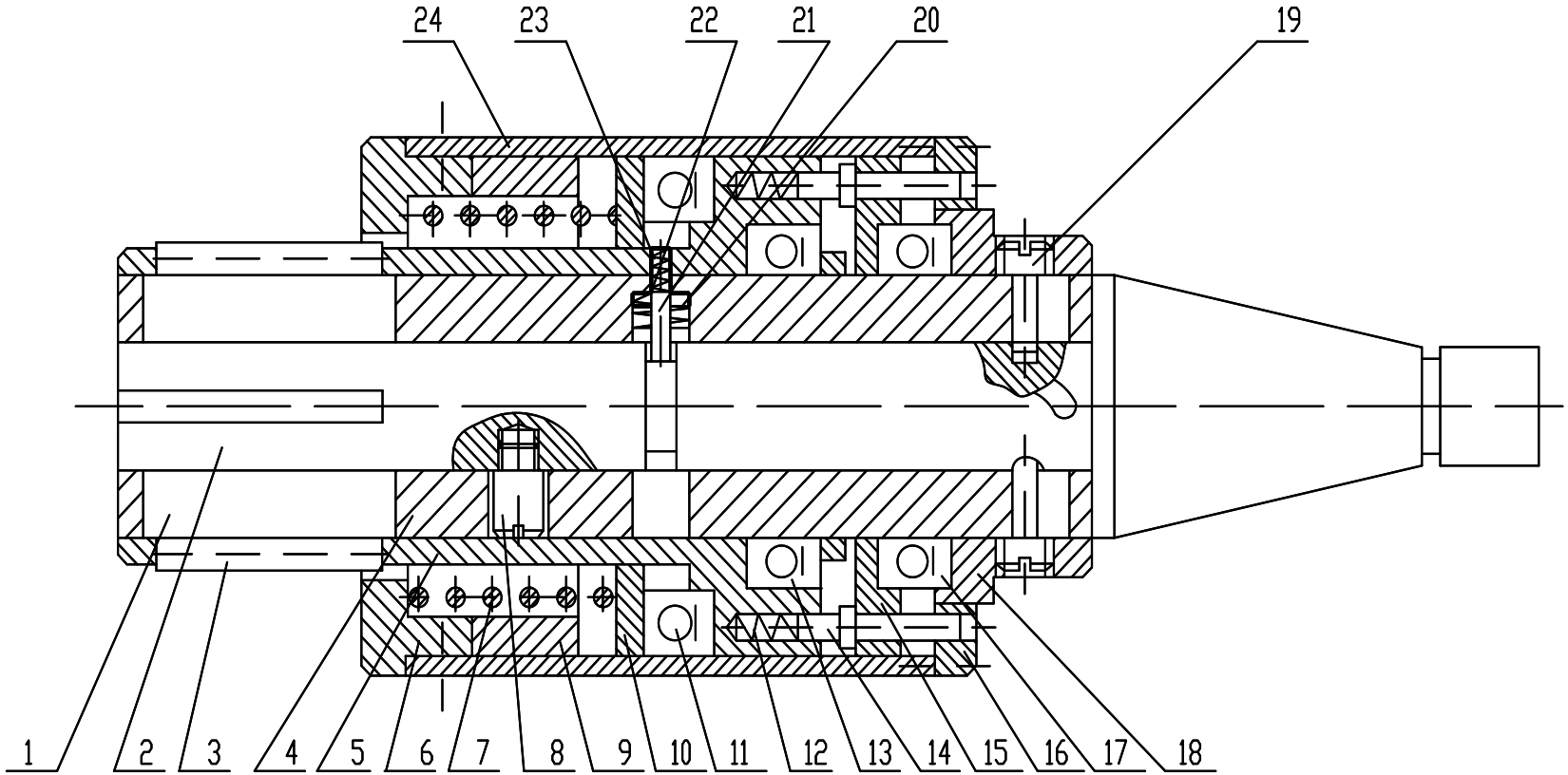

Figure 1: *Tool with a single radial feed for treatment of hole*

extruders 1 stand against the flat shaft sections 2, 3. The deformation rolls, liaising with the working surface of extruders, ensure clearance, required for free axial movement of the tool in the treated hole.

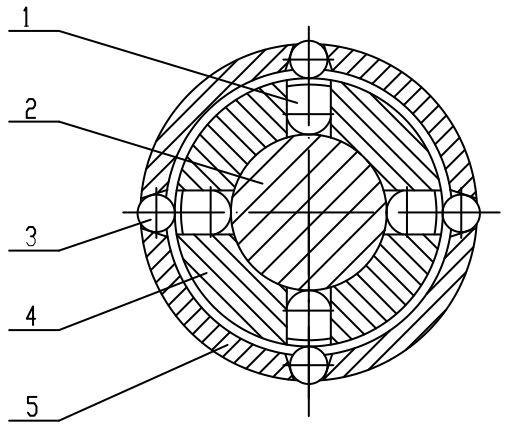

Figure 2: *Cross section of the work of the instruments of Figure 1*

Processing with the instrument is performed in the following order: through a tapered tail of a shaft 2 the tool is established in the spindle of the machine; through axial movement the work part of the instrument is introduced into machined hole; after the contact of the cover 6 with the forehead of workpiece, axial movement continues for a while, in which spring 7 shrinks so that the friction contact between the cover 6 and the forehead to ensure necessary torque moment, enough to ensure stationary casing 24 in next stages of the working cycle; at the time of termination of the axial movement of the shaft 2 to the workpiece, pin 21 contacts with the most protruding part of the cam surface of the support shaft, in which the cup 22 of the synchronize device is located in the stopper hole of the separator and, as a result, blocks the ability to turning toward the mounting sleeve 4. At the same time, the pins 14 are still not completely out of the stopper holes on the rear cover 16, which is a condition providing the immobility of the separator 5; rotation of the support shaft 2 is implemented by turning on the main rotary movement of the machine at which in the period moving of the pin 8 within the sector clipping of the bearing sleeve, none of the structural elements of the instrument does not receive a circular motion. During the period of relative rotation of the shaft 2 toward the sleeve 4 extruders 1 pass over cylindrical sections of shaft 2 and cause radial movement of the deformed rolls. At the end of this period the pin 21 contacts with the lowest section of the cam surface, in which, under the action of the spring 20, the cup 22 releases stopper hole of the separator, giving it an opportunity to free rotary movement toward the supporting sleeve.

The same time, at the end of that period, by screw channels and placed in them the pins 19, are provided such axial movement of the slider 18, which, by the action of pulley 15 to allow complete removal of the pins 14 of the detent holes on the back cover 16, thereby is reached freeing the separator for rotary movement toward stationary casing 24. At the time of unlocking the stationary casing, bearing sleeve and casing the pin 8 is reached the end of the segment clipping of the sleeve 4, in which the further rotary movement of the support shaft is carried along with it. The joint rotary movement of the shaft 2 and the supporting sleeve with provided integrity of its outside cylindrical surface causes planetary movement of the deformation rolls distorting around the axis of the hole, with which its processing carries out, too. The tool is bring out from treated hole by reversing of the main movement and then axial moving to the initial position of the tool or the workpiece, depending of the type of used machine. Radial relocation of extruders is performed by cylindrical rollers 6, placed within the channels of extruders which, during the period of wedging, are rolled on the surfaces of the plane sections of the support shaft.

Figure 3 shows the structure of a tool with interrupted action and dynamic application of the technological impact. The originality of the design is expressed in a combination of the work part of the tool with planetary gears by which the desired ratio between the separators of the percussion and deformed rolls, is achieved. The tool itself is suitable for using in universal console milling machines, and by changing of its work part, which is built in the separator with deformed rollers, it is possible to treat holes with diameters in a appointed range. The presented structure is able to achieve the desired smoothing effect depending on the availability of asynchronous or adjustable power of the used milling machine.

The tool consists of shaft 1, passing freely through the hole of the queue 2 and the guide sleeve 3, nut 4, housing 5 of planetary gears, gear-wheel 6, immovable fixed by bolts to the housing 5, axle 7 of the satellite 8, gear-wheel 9, immovable fixed to the shaft 1; conductor 10,

separator for deformed rollers 11, immovable fixed by treated joint to the housing 5, separator 12 with percussion rolls, connected by top gear joint to the conductor 10; supporting axle 13, percussion rolls 14, appearing in nests separator 12; deformed rolls 15 appearing in nests in the separator 11, cap 16. In establishing the instrument to the machine the top of shaft 1 is pull out through the spindle and engages immovable to the body of the milling machine so that it is fixed to the gear-wheel 9. Rotary motion of the spindle is transmitted through the tapered queue 2 and guide sleeve 3 of the conductor 10, and from it to the separator 12, bearing percussion rollers 14. By the satellite 8 the movement is transmitted to gear-wheel 6q and from it - to the housing 5, which drives the separator 11 performing rotary feed movement.

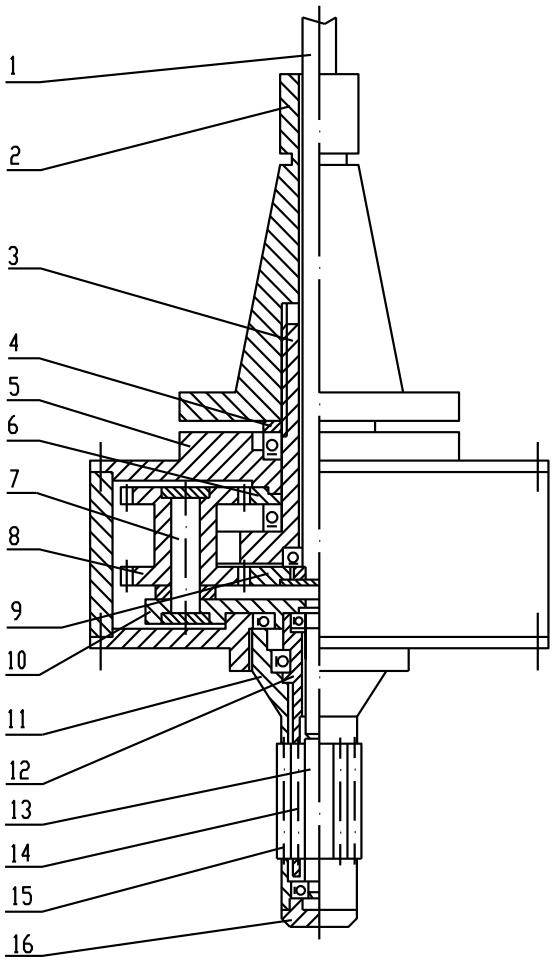

Figure 3: *Instrument for SPD with interrupted action and dynamic application of technological impact*

3. Conclusion

- The presented instruments for SPD of holes have structures in which the utmost account are pledged the advantages of using deformed cylindrical rollers, operating under axial feed;
- For the instrument of Figure 1 is typical achievement of smoothness and minimizing the length of the operating cycle
- For the tool from Figure 3 is provided transiency of the deformation impact over the treated surface, which allows the application of SPD in details with low or unequal stability;
- In both instruments are used deforming elements which allow selection of desired diameters and achieves high performance processing.

References

[1] Sutchkov, A., Kostadinov, V., Karshakov, M., Grigorov, V., *Conditions for Appluing of Instruments for the Finishing Processing of Holes Through Surface Plastic Deformation.* MECHANIKA – proceedings of the 12th International conference, "Technologija", Kaunas, 2007, p.158-162, ISSN 1822-2951

[2] Костадинов, В. С., *Теоретични основи, конструиране и изследване на инструменти за ППД, работещи с радиално подаване,* Автореферат на дисертация за к.т.н., С., 1987

[3] Кършаков, М.К., *Довършващо обработване на вътрешни цилиндрични повърхнини чрез инструменти за ППД, работещи с периодично радиално подаване,* Автореферат на дисертация за к.т.н., С., 1988.

[4] Сучков, А. Г., *Теория и пресмятане на инструменти с динамично действие за обработване на вътрешни цилиндрични повърхнини,* Хабилитационен труд за научно звание „Професор", Русе, 1976.

[5] Григоров, В. И., *Довършващо обработване чрез ППД на отвори в тънкостенни и неравностенни детайли посредством инструменти с динамично действие,* Автореферат на дисертация за к.т.н., С., 1990.