AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Pedagogical and Educational Research
ISSN (E): 2832-9791| Volume 39, |August - 2025

PRINCIPLES OF OPERATION OF THE STEADY REST

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A B S T R A C T

This article includes the process of machining various deep hole surfaces using a steady rest. This process improves surface cleanliness and provides high quality. For the creation of small-diameter deep holes, it is advisable to use methods that ensure high precision and surface cleanliness, enhance the machinability of parts, and maintain a surface hardness of no less than HRC≤445. These include burnishing and broaching methods.

Purpose:
To identify technological shortcomings and defects in steady rest operations, suggest advanced technical and technological improvements, and implement them in production to extend tool life and increase labor productivity.

Methods:
1. Analyze methods for machining small-diameter deep holes.
2. Analyze materials used for tools in machining such holes.
3. Propose optimal methods that achieve high precision and cleanliness.

Results:
The steady rest process can be applied in various sectors such as the automotive industry, mechanical engineering, light, and chemical industries for machining small-diameter deep holes.

Conclusion:
Using steady rest technology improves the coefficient of performance. It also enhances surface cleanliness, reduces waste, and increases labor productivity. The wide use of burnishing in mechanical, aerospace, and military weapon manufacturing ensures product compliance with standards.

K E Y W O R D S

Steady rest, burnishing, drilling, taps, reamers, boring tools, lathes.

INTRODUCTION

Principles of Operation of the Steady Rest

As a tool, hard alloy balls are important due to their high hardness, durability, and precision. However, special equipment is needed to produce them. When burnishing small-diameter holes using balls, only slight tension is required. For example, 1 mm balls should not exceed a contact tension of 0.015 mm at an angle of no more than 10° with the workpiece. Greater tension during burnishing leads to deposit formation.

One drawback of ball burnishing is the misalignment of the hole relative to the axis. Broaching overcomes this issue, especially when using hard alloy broaches. It is recommended to avoid bending loads when the tool enters the workpiece. Therefore, the broach should be tightly mounted to the guide sleeve, which is made from elastic antifriction material (fluoroplastic). Additionally, self-centering systems between the tool and workpiece should be implemented.

However, information on self-centering systems is limited. As a result, the technological importance of burnishing in manufacturing is not high. Still, for machining small-diameter deep holes, this process is essential.

Currently, deep hole burnishing using broaches or balls employs special machines and various presses equipped with specific devices. One key component of these machines is the pusher-holding part, which provides the necessary force.

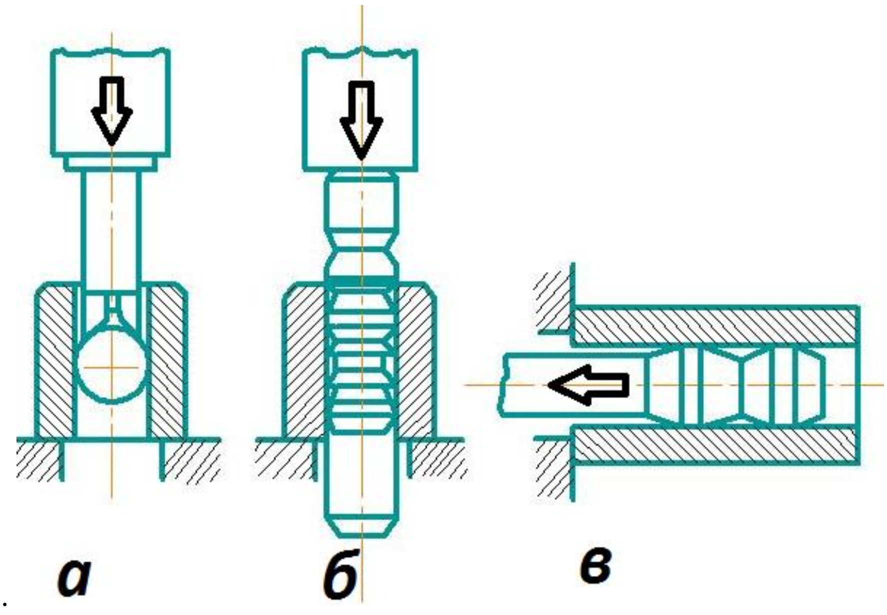
The structure of a continuously operating steady rest includes several moving plates connected with a washer and a pusher installed in the central hole. The remaining holes are guided by a cylinder fixed to the machine base. During operation, the guide directs the pusher forward and back to its initial position.

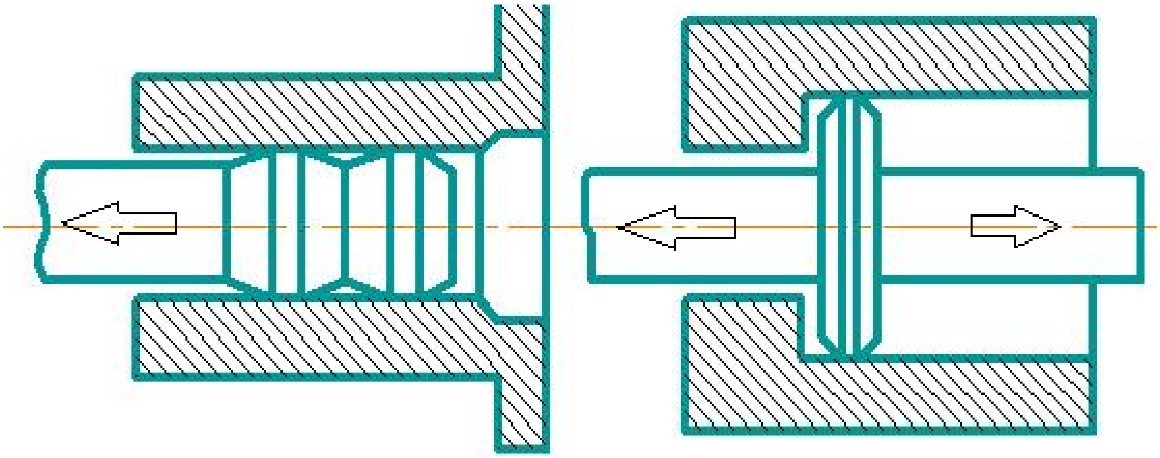
Another schematic shows a device for deep hole burnishing. It includes a body with an installed cup and a sleeve, between which a spring is placed. A pusher passes through the central hole of the sleeve and is fixed to the press rod. The body also includes a socket aligned with the cup containing the broach and a retainer mechanism consisting of a ball and spring to secure the broach in the required position. During downward movement, the pusher pushes the broach through the hole of the workpiece. Simultaneously, the sleeve slides downward under the spring's influence, holding the pusher. As the rod moves upward, the sleeve returns to its initial position with the help of the spring.

One drawback of this device is the difficulty in maintaining the pusher in the required position due to the excessive length needed for deep holes, reducing its rigidity and complicating its manufacturing, leading to larger device dimensions.

Analysis of the literature reveals that no standardized methods exist for burnishing small-diameter deep holes. Therefore, we set the following objectives:

- Identify methods for self-centering in the tool-workpiece system.
- Propose designs for technological systems that perform burnishing.
- Study precision and surface roughness during burnishing and offer recommendations.





1. **Ball Burnishing**

1. Machining small-diameter deep holes (d=1...3 mm, l=4...100 mm) in mechanical engineering is a complex task.
2. These holes, made from various metals and alloys, are usually produced using drilling, electrochemical, and electro-erosion broaching methods. Laser and electron-beam methods are also used.
3. For difficult-to-machine steels, electrochemical broaching is appropriate (d=1...2 mm, L≤200 mm), achieving accuracy up to grade 12.

If D/d≥3, to achieve high precision (IT6, IT7), general tension in burnishing should be ~0.01d, and pitch tension 0.01–0.05 mm. Greater tension reduces hole accuracy and deforms end surfaces, causing metal flow.

For D/d≥3 workpieces with 1...3 mm holes, general tension of (0.05...0.1)d is achieved. Hole deviation does not exceed 0.02 mm. Therefore, relative general tension is suitable for thick-walled workpieces, even higher than recommended values for larger diameters.

Burnishing is actively used for finishing high-precision holes, particularly in firearms production for rifle barrels.

[The article includes a complete reference list supporting the research.]

Conclusion

The use of steady rest technology significantly enhances the efficiency of machining operations. It improves the coefficient of useful work, surface quality, reduces material waste, and increases labor productivity. The widespread application of burnishing processes in mechanical engineering, aviation, and military production ensures compliance with technical standards and increases the quality of the final products.

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