4. Nakao Y., Kirigaya R., Fedorynenko D., Hayashi A., Suzuki K. (2019): Thermal Characteristics of Spindle Supported with Water-Lubricated Hydrostatic Bearings. Int. J. Automation Technol., Vol.13, No.5, pp. 602-609.

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MECHANISM WITH VARIOUS FUNCTIONS OF KNIFE BLADE MOVEMENT

There is a wide variety of methods for trimming sheet materials, which significantly influence the quality indicators of the final finishing of printed products. Continuous trimming methods and devices have a number of advantages over stationary cutting methods, namely: increased productivity; reduced time for equipment adjustment; energy savings during the process; improved cut quality; reduced metal consumption and dimensions, etc. For this reason, machines with movable knives have become widespread [1–7].

The author has proposed an improved version of the trimming mechanism for sheet materials (hereinafter – SM) described in works [6–7], which includes a knife (1) mounted in a frame (2) (Fig. 1), kinematically connected to a slider (3), which in turn is installed in a guide (4). A pair of pins (5) are mounted on the frame (2), and a shaft (6) on which a pair of eccentrics (7) are installed with adjustable positions, kinematically connected to the pair of pins (5) by means of a pair of double slotted links (8), installed in a pair of guides (9). Shaft (6) is mounted in a pair of supports (10).

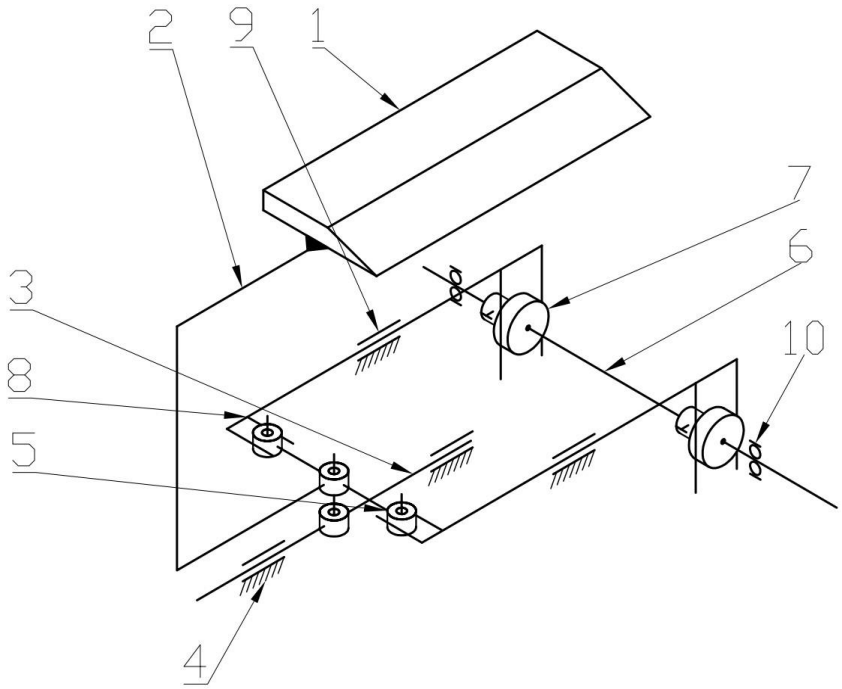
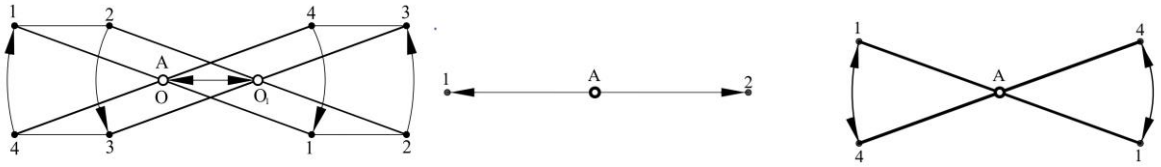


Fig. 1 – Kinematic scheme of the sheet material trimming mechanism

The presence of two driving links (eccentrics 7) in the mechanism is due to the fact that the knife receives two types of motion when the eccentrics 7 are set with a phase angle of 90°: reciprocating motion in a direction perpendicular to the SM movement, and reciprocating-rotary motion in a direction perpendicular to the SM movement. The trajectory of point A located on knife (1) and coinciding with the center of oscillation is a straight line (OO1) perpendicular to the feed plane of the SM (Fig. 2a). The trajectory of any other point on the knife edge has a complex path. From the initial position (1-1), the blade performs a linear motion in a plane perpendicular

to the feed plane of the SM to position (2-2). Then, the blade rotates about point O1, which coincides with the oscillation center, from position (2-2) to position (3-3). During this rotation, all points on the knife edge (except point O) move along a circular arc centered at point A.



a) b) c)

Fig. 2 – Diagrams of knife movement depending on the phase angle between driving links: a) 90°, b) 0°, c) 180°

After the rotation ends at position (3-3), the blade performs a linear motion in a plane perpendicular to the SM feed plane to position (4-4). From position (4-4), the knife blade rotates about point O, coinciding with the oscillation point, back to position (1-1). When the eccentrics 7 are set with a phase angle of 0°: knife (1) only performs reciprocating motion in a direction perpendicular to the SM movement (Fig. 2b). When the eccentrics 7 are set with a phase angle of 180°: knife (1) only performs reciprocating-rotary motion in a direction perpendicular to the SM movement (Fig. 2c).

This design of the sheet material trimming mechanism simplifies the overall structure by using a pair of double slotted links, reduces manufacturing costs, and improves the dynamic behavior of the mechanism compared to the construction described in works [6–7]. Additionally, this design reduces energy consumption in the technological process due to the diverse functions of knife movement.

References

1. Ivanko A.I. Mechanics of the trimming process for book and magazine blocks with disk knives with a planetary drive: PhD thesis in Technical Sciences: 05.05.01 / Andriy Ivanovych Ivanko. – Kyiv, 2007. – 181 p.

2. Makatora D.A. Parametric synthesis of working bodies of a machine for longitudinal cutting of shoe materials: PhD thesis in Technical Sciences: 05.05.10 / Dmytro Anatoliyovych Makatora. – Kyiv, 2020. – 312 p.

3. Makatora D.A. Knife movement mechanisms performing planar-parallel motion in machines for longitudinal cutting / D.A. Makatora // Bulletin of the Engineering Academy of Ukraine. – 2018. – No. 2. – P. 137–141.

4. Makatora D.A. Machines for splitting and leveling the bottom parts of shoes by thickness, with a rotating knife / D.A. Makatora, V.I. Knyazev, V.S. Chorno-Ivanov // Bulletin of Kyiv National University of Technologies and Design. – 2005. – No. 2. – P. 32–37.

5. Makatora D.A. Machines for leveling the bottom parts of shoes by thickness, with a movable knife / D.A. Makatora, V.I. Knyazev, V.S. Chorno-Ivanov // Bulletin of Kyiv National University of Technologies and Design. – 2005. – No. 3. – P. 35–40.

6. Patent No. 47277 Ukraine, IPC A43D 8/00. Machine for leveling shoe parts by thickness / V.I. Knyazev, V.S. Chorno-Ivanov, D.A. Makatora, A.O. Sakovtsev; applicant and patentee – Kyiv State University of Technologies and Design – No. u2001106802; filed 05.10.2001; published 17.06.2002, Bulletin No. 6.

7. Makatora, A. Mechanism for cutting root folds in book blocks with plane-parallel movement / A. Makatora, D. Makatora // The latest science and technology achievements and their significance for society (December 6–7, 2023, Częstochowa, Republic of Poland). – Riga, Latvia: Baltija Publishing, 2023. – Pp. 29–31.