A DEVICE FOR THE MACHINING OF INTERNAL SPHERICAL SURFACES ON TABLE SAW

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Abstract

The article describes an appliance as well as a method of processing of internal spherical surfaces in wood on a universal circular sawing machine. The proposed device expands processing possibilities of this machine tool and is intended for single-piece production. A prototype of the device was made on which technological tests were carried out and satisfactory results were obtained.

Key words: *spherical surface, table saw, wood machining*

1 INTRODUCTION

Internal spherical surfaces can be found in many different objects made of wood. These are, primarily, articles of the so called wood accessories and household goods as well as decorative elements of internal design. In practice, majority of such types of surfaces are made employing turning on different kinds of wood turning lathes (Kien 2003a, 2003b, Kien, Osajda 2007). Other methods used for such purposes include milling (on milling machines as well as in processing centres) (Kien 1996) and the so called 'milling-turning' carried out on a lathe equipped with an assembly working with a disc cutter. As commonly known, multi-edge disc cutters of considerable diameters are quite similar to circular saws used in circular sawing machines, including table saws.

2 SOLUTION

2.1 General description of the device

Internal spherical surfaces of considerable radius ("wash-basin" type of shape) processed employing a rotary tool which allows the operation to be performed using a circular (joiner) saw (Kien, Sydor, Kortylewski 2010). An example of such equipment is shown in Fig. 1. In the case of the presented solution, a standard support arm of a low spindle milling machine fixed to a sawing machine table was applied. The tool, together with the processed element, is fastened rotationally in the arm bearing and the circular saw in placed under the element. The processing with the assistance of the device involves lifting the saw to a definite height appropriate to the thickness of the machined layer and making a full left or right turn with the tool. These rotations are repeated as many times as necessary milling consecutive layers depending on how deep the spherical surface is to be.

Experience gained from unconventional processing on lathes (Kien, Osajda 2007a, 2007b) demonstrated that the applied circular saw with inserts of sintered carbides used instead of the special tool (disc cutter of large diameter) is capable of processing partially with side tooth edges, provided the thickness of consecutive cut wood layers is not too big. Therefore, also for securing appropriate safety, it is advisable to 'lift the saw up' as many times as possible. It is true that this type of processing is time-consuming but for a craftsman who has no appropriate lathe at his disposal, this solution may be of considerable assistance in the case of individual orders

The performed technological tests confirmed that the circular saw equipped with inserts made of sintered carbides can operate as a milling cutter when the consecutive cut wood layers are sufficiently thin (Kien 2007b).

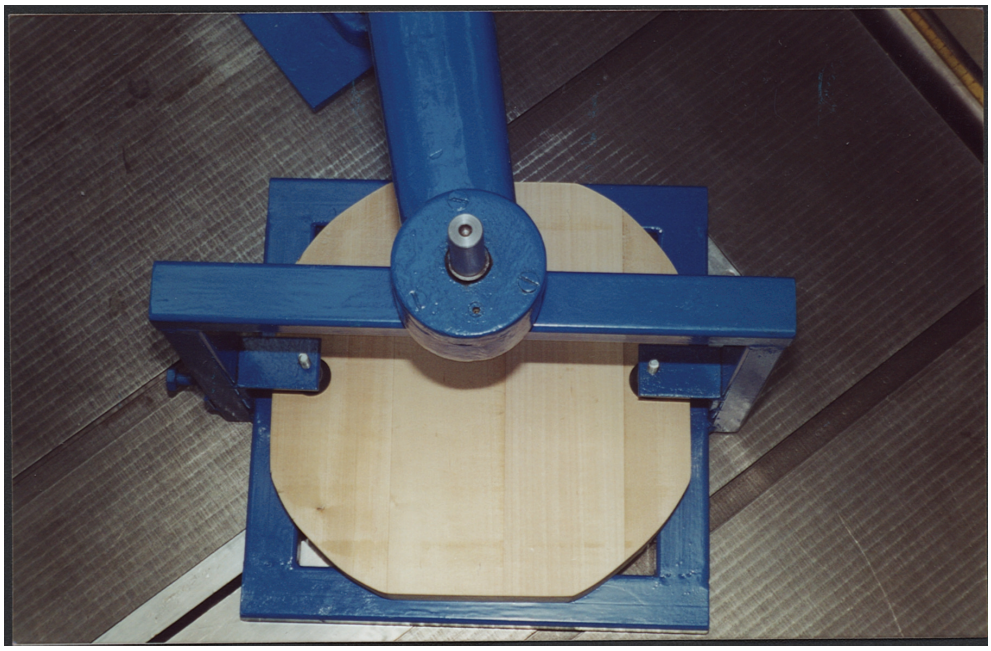

Fig. 1 Photo of the device mounted on a universal circular saw (view from top)

The described processing device makes it possible to manufacture, in a simple way, single and small series internal spherical surfaces using for this purpose a machine popular in wood industry without the need to purchase an expensive, specialised lathe.

The above-mentioned 'milling-turning' of external spherical surfaces with the assistance of a device equipped with edges in a form very similar to the toothing of a circular saw (especially a saw with inserts made of sintered carbides) showed that the unconventional 'milling' work of the saw (assuming that the thickness of consecutive cut wood layers is not too big) need not have a negative impact on the tool-life and processing safety (Kien, Osajda 2006).

2.2 Principle of device operation

The device, together with the machine tool, is presented in the form of block-diagrams in Figure 1. The longitudinal guide (1) is situated on the bench of the sawing machine and

it is possible to move it crosswise as well as to block it in a set position. An angular bracket (3) is bolted to the longitudinal guide (1) and a column (4) is fixed to the bracket. A bearing (5) makes it possible to turn the arm (6). On the other hand, the bearing (7) allows mandrel (8) which is connected by a threaded joint with the stand (9) to turn. The horizontal part of the support arm (4) is mounted in a vertically slidable manner. Thanks to this, it is possible to make appropriate adjustments so that, during the processing, it is not be possible for the device to be lifted above the table (2) of the sawing machine. The stand (9) is mounted permanently on the frame (10) which provides the device base. The bottom part of the frame (10) is equipped with skids (11) which facilitate rotational sliding of the device on the table (2) of the sawing machine. The processed object (12) rests on the frame (10) and is fixed with clamps (13). Prior to its fixing, the position of the object is adjusted with the assistance of adjusting screws (14). In order to prevent contact of the saw with the steel frame (10) during processing, an optional safety lock (15) can be provided which is fixed on the working assembly (fixed headstock) of the sawing machine in place of the separating wedge.

In addition, the presented kinematic diagram shows the system of saw lifting and lowering (16) with the assistance of a manually operated wheel (17) as well as the system of saw tilt (18) also operated using a manually operated wheel (19). The saw tilt can be useful when working internal spherical surfaces (20) of different position in relation to the object processed surface (10).

The mechanical processing of an element with the described device runs according to the following stages:

1. Dismantling from the circular sawing machine the saw guard and the separating wedge and then mounting, in their place, a safety lock (15) which prevents excessive protrusion of the saw.
2. Using the provided manually operated wheel (19), the saw is lifted to the height which will make it impossible for the teeth to protrude over the surface of the working table.
3. The processed object (12) is then placed on the frame (10) and its position is adjusted with the assistance of adjusting screws (14) and next it is fixed in this position using clamps (13).
4. The device mandrel (8) should be placed in the column (4) bearing (7) and fixed in a position allowing the mandrel (8) axis – which constitutes the rotation axis of the device – to be situated in the saw plane (16).
5. After switching on the working drive of the sawing machine, the saw (16) is lifted using the hand-operated wheel (19) until it touches the object (10). Further manipulations involve gradual jutting out of the saw and turning the processed object round its own axis by the angle of 360o. In this way, the saw (16) mills a spherical bowl (20) in the processed object (10) of increasing depth as the saw (16) keeps protruding more and more. Consecutive protrusions of the saw (14/16) are continued until the safety lock (13/15) gets in contact with the table and further protrusions of the saw become impossible.
6. The extent of the safety lock (15) allowance is set each time before the beginning the processing depending on the saw diameter and the required depth of the spherical bowl.

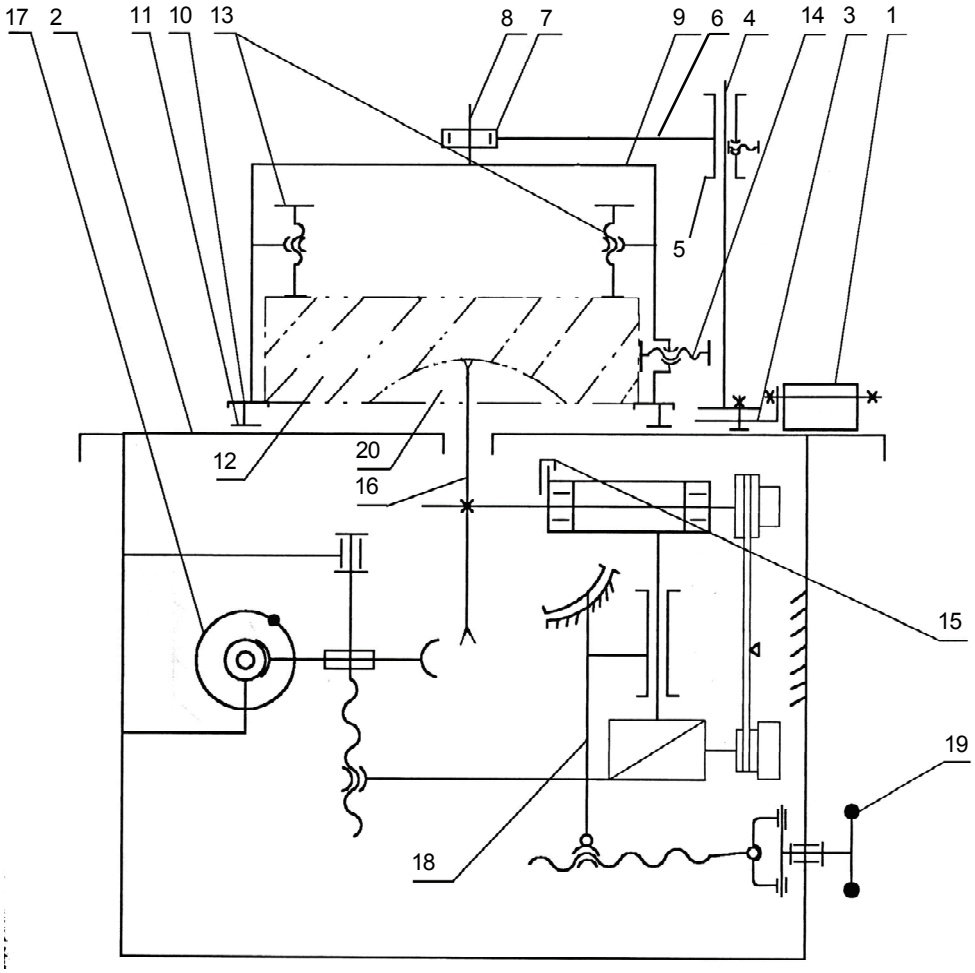

Fig. 2 Kinematic diagram of the device mounted on a machine tool

Results of operations achieved using the described device are presented in Figures 3a, 3b and 3c.

Figure 3a shows one of the methods of processing in the proposed device. In this case, the rotation axis is placed in the symmetry plane of the saw disc (16) and cuts across its axis of rotation. The result of such processing is an internal surface which constitutes a spherical bowl (20) with the radius which equals that of the saw (16) radius.

Figure 3b shows another way of processing in the described device. This time the axis of rotation of the considered device is parallel to the symmetry plane of the saw disc (16). The result of processing is a sum of a spherical bowl (20) with the radius equal to the radius of the saw and a cylinder (21) of the base radius equalling that of the displacement of the rotational axis in relation to the saw plane.

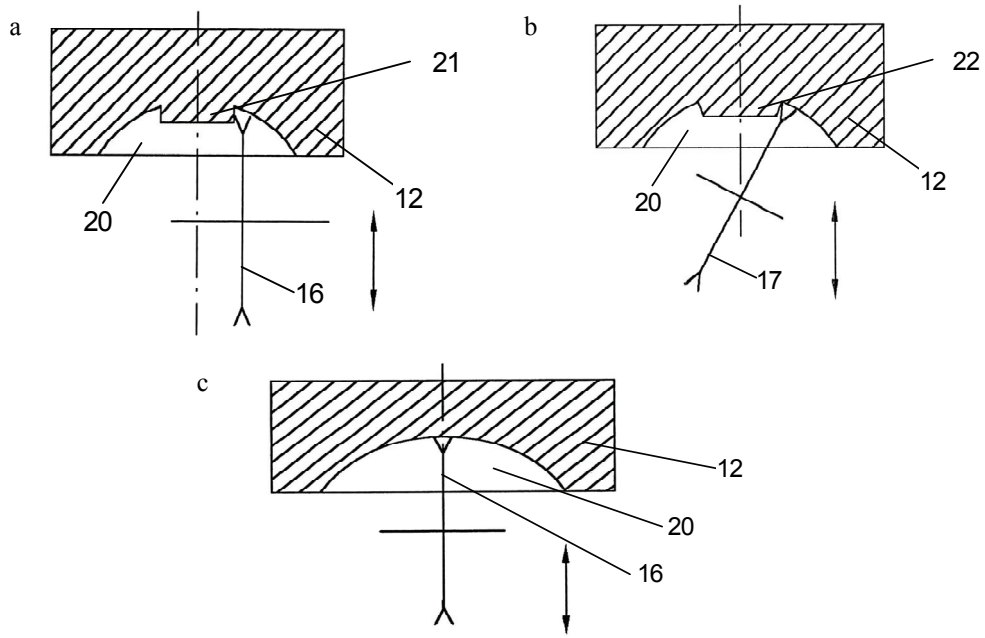

Fig. 3 Different methods of machining in the device

Figure 3c shows still another way of processing in the described device. This time, the axis of rotation of the device is not parallel to the symmetry plane of the saw disc (17). The result of processing is a body which is a resultant of the bowl and cone.
It is also possible to combine all the above-described types of processing during the working of one object.

SUMMING UP

The described device for making concave spherical surfaces in wood and wood-derived materials which is treated as an additional attachment for a universal circular saw machine is characterised by the fact that an object mounted on it can perform a rotational movement turning round a vertical axis (feed) at the same time when the circular saw rotates round its own horizontal axis (main motion). The removal of consecutive layers of material during processing takes place with the assistance of a mechanism which lifts the saw up.

The proposed device is characterised by a simple construction possible to make in average workshop conditions. It appears to be particularly useful in situations when only a single specimen of a given construction is to be produced. The proposed piece of equipment provides an additional proof that if such additional devices can be manufactured in a small workshop by users of wood machine tools, they give unlimited possibilities of expansion of technological operations. The proposed device can find application in a craftsman's workshop who secured an order to manufacture an object with an internal spherical surface but has no appropriate lathe.

The device is subject of a patent No. 205242 granted by the Patent Office of the Republic of Poland (Kien, Sydor, Kortylewski 2010).

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