MILLING DEVICES FOR WOODEN CYLINDRICAL RODS

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Abstract: *Two new devices for making circular cross-sectional wood rods are described. The first device is intended for the production of cylindrical wooden rods within the range of 6-12 mm diameter and their length between 150 mm and approximately 1000 mm using for this purpose the wooden rod with square section and hand drill. The same device can also be used for cylindrical slitting, in the range of 6-15 mm diameters, of the heads of wooden rods with square section having the side dimension larger than these diameters. The second device is used to produce cylindrical wooden rods of square sections with a long length in the range of diameters between 10-50 mm. The device is designed to equip endless rods milling machines and ensures between two sharpening knife resistors a working life of about four times greater than the service life of the two classical cutting tools that fitted these machines.*

Key words: *devices, cylindrical rods, wood*

1. Introduction

Wooden rods of circular cross-section and wooden rods with square section cylindrical bevelled at one or both ends are important auxiliary elements in the furniture industry, wood toy industry and carpentry. For this purpose there is a great variety of equipment and devices [1],[2],[3],[4],[5] the best equipment is the revolution milling machines in which the milling cutter is rotated around the semiproduct or longitudinal milling machines, equipped with two milling cutters, each of them realizing a semicylinder of the square section. Due to low productivity, lathes are used less frequently for the production of cylindrical wood rods [6],[7]. The issue of these equipments is related to their performances in terms of productivity, quality, purchasing and production prices, as well as the fact that they are intended to provide internal needs or national or international market [4] [5]. For cylindrical sharpening of both ends or of one end, of square or circular cross-sectioned wooden rods, specialized machines with automatic feeders and automatic advance are used [2]. For cylindrical limb of a wooden rod with a square section or a circular section at both ends or at one end, specialized machines are used. The issue of the cylindrical limb machines at the ends is similar to that of the cylindrical wooden rods manufacturing equipment. This paper seeks to solve a number of negative aspects of this issue.

2. Device for obtaining cylindrical wooden rods

2.1. Device for obtaining cylindrical wooden rods of diameters and small lengths

Carpenter workshops often need small quantities of thin cylindrical wood rods with diameters between 6 and 15 mm. Supplying such rods is difficult and the purchase of specialized machinery is not economical because the needs of these workshops are far below the production capacity of such industrial equipment.

The situation is similar when it is desired the cylindrical limb of both ends or one end of a wooden rods with square section. By using a simple, high-performance and low-cost device [8] to produce circular cross-sectional wood rods in the diameter range of 6 to 15 mm, in lengths between 150 mm and 1000 mm, the needs of these workshops can be

covered successfully. Not unimportant similar necessities appear in various other craft workshops and even in individual households.The device also makes possible the cylindrical limb of both ends or of one end of wooden rods with square section, the square side being between 8 mm and 18 mm and the lengths of the wooden rods with square section being also between 150 mm and about 1000 mm. The device is a modular structure in which a steel body is mounted, on which are mounted two rapide stainless steel knives or tool steel knives, adjustable for different diameters of cylindrical rods or cylindrical plugs, spacers for adjusting the milling diameter, a rod guide for long cylindrical rods manufactured and a length plugs limiter system. The described assembly is fastened and tightened in a steel bench vise, Fig.1, Fig.2. Fig.3.

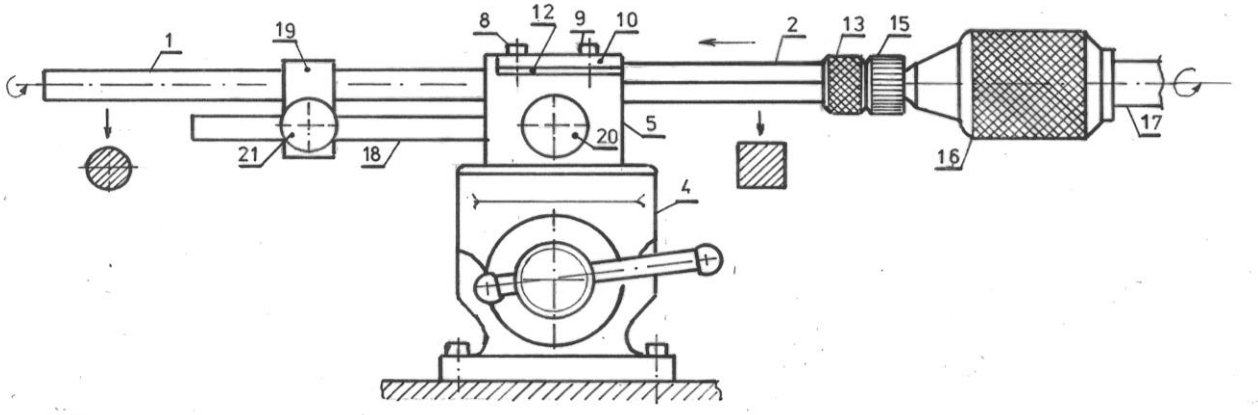

Figure 1. *The kinematic chain of the device used to produce wooden rods with circular cross-section from wooden rods with square section. 1-rods of circular cross-section. 2- wooden rod of square cross-section, 4- steel bench vise, 5-steel body, 8,9-bolt clamping, 10- cutting knife, 12- steel plate, 13, 15-drive bodies, 16-chuck, 17-drive shaft, 18-cylindrical steel rod, 19-rod guide, 20,21-tightening screws*

In the device structure there are also a series of drive heads used for different sections of square semiproducts. In order to produce wooden cylindrical rods and cylindrical plugs, a manual drilling machine is also required by which the carpenter transmits the rotational movement to the wooden semiproduct with a square section and the longitudinal feed to the steel body on which two cutting knives are mounted.

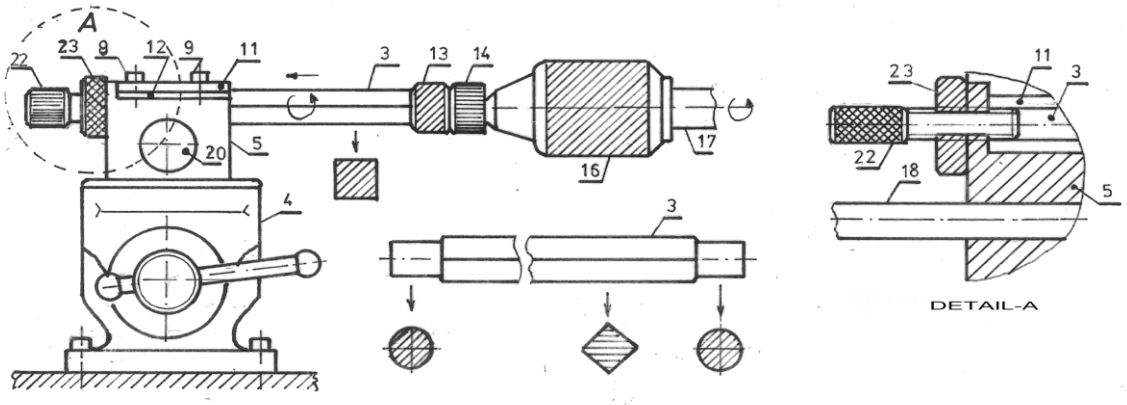

Figure 2. *The kinematic chain of the device, with constructional detail, used for the cylindrical limb at the ends of wooden rods with square section. 1- wooden rod with circular section, 2,3- wooden rods with square section, 4-metalic bench vise, 5-body steel, 6,7,8,9-clamping screws, 10,11-cutting knives, 12-plate steel, 13,14,15-drive bodies, 16-steel chuck, 17-drive shaft, 18-cylindrical steel rod, 19-rod guide, 20,21- clamping screws, 22-adjusting screw, 23-lock nut.*

The advantage of using the device lies in the fact that it is possible to produce wooden cylindrical wood rods from semifinished products of square section and cilindrical limb of the ends of wooden squares with the square section with a minimum material and physical effort. In order to achieve some wooden rods *1* with circular cross-section, diameter in the range of 6-12 mm, from wooden rods *2* with square section and as well as of cylindrical limb at the ends of the rods *3* with square cross-section, the apparatus described, a manual electric drill and a metal bench vice *4* are used.

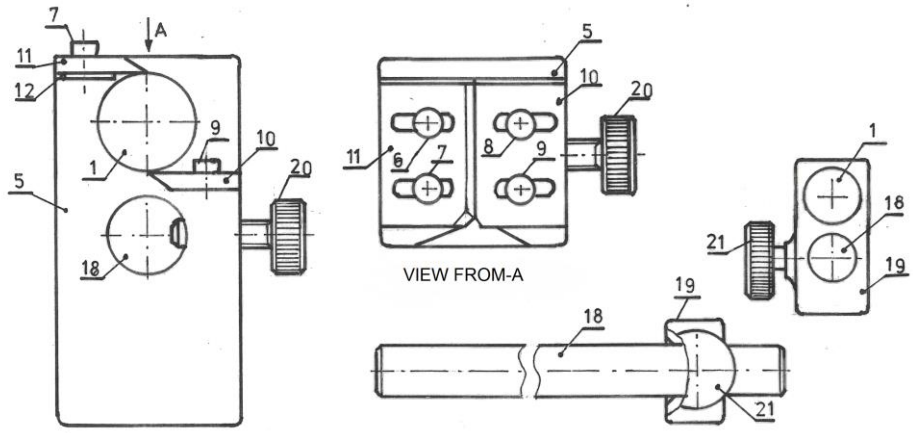

Figure 3. *View of the device, with elements annex and construction details, used to make wooden rods of circular cross-section from wooden rods of square section and for the cylindrical limb of wooden rods with square section at the ends. 1-wooden rod of circular section, 5-body steel, 6,7,8,9-clamping screws, 10,11-cutting knives, 12-plate steel, 18-cylindrical steel rod, 19- guide, 20,21 - clamping screws*

The device of Fig.1, Fig.2, Fig.3, consists of a steel body *5*, on which are fixed with four screws *6,7,8* and *9* the two cutting knives *10* and *11*, Fig. 4 with an angle of attack of 70^o and a tilt angle of 0.5 °, each provided with two longitudinal grooves to compensate the shortening thereof as a result of repeated resharpening.

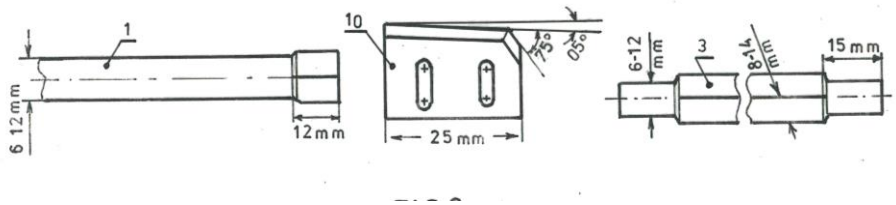

Figure 4. *The geometry of the cutting knifes, geometry and dimensional characteristics of wooden rodswith circular section and geometry and dimensional characteristics of wooden rods with square section cylindrical limb at the ends. 1- wooden rods with circular section resulting after milling of rods 3,2 with square section, 10-splintering knife.*

In order to achieve different diameters of cylindrical rods 1 and cylindrical plugs from wooden rods 3 with square section, in the diameter range of 6-12 mm, there are used steel spacing plates 12 of different thicknesses, rectified parallel plane which have the thickness value equal to 1/2 of the desired change in diameter relative to the previously used milling diameter. In order to ensure the movement of rotation and longitudinal feed of wooden rods *2* and *3* with square cross section are heads of the driving of the steel in two parts, joined by screwing, made according to the type of operation carried out, in four bodies *13* with square cross-section , Fig. 5a, having the side of 13 mm, 11 mm, 9 mm and 7 mm, a body *14* with a circular section, Fig. 5b, having a 12 mm circular cross section and a straight back body *15.*

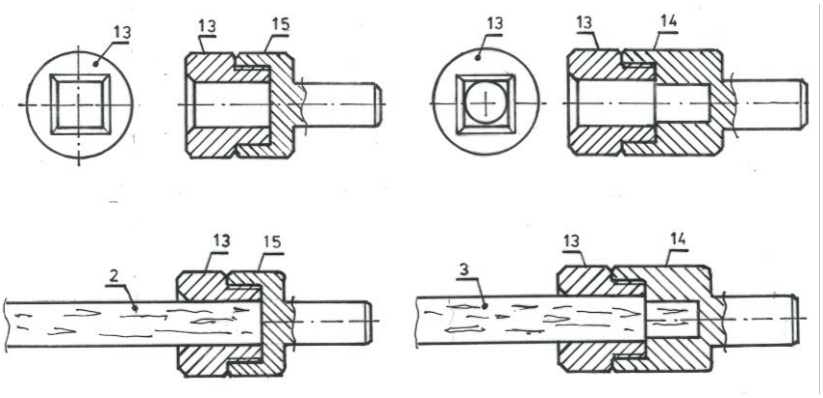

Figure 5. *The drive system (a) used for rotating and advancing the square-sectioned wood rods for obtaining circular cross-sectional wood rods and the drive system (b) used for rotation and advancement of the square-sectioned wooden rods 3 subjected to cylindrical limb of heads. 2,3- wooden rods with square section, 13,14,15-drive bodies*

The drive ends are clamped into a chuck *16* driven in turn by the shaft *17* of a manual electric drill. In the device structure there is also a steel cylindrical rod *18,* which together with the guide *19* and two dowel screws *20* and *21* provide centric guiding of the wooden rods *1* with circular cross-section and a long length after milling them from the wooden rods *2* with square section. In order to determine the desired length of the cylindrical plugs of the square-sectioned wooden rods *3*, a limiting screw *22* is provided, having the rod-shaped head threaded into the body *5* of the device up to the desired depth for the cylindrical plug and a shank *23*, that locks the bolt *22* into the set position.

The operator mode for obtaining circular cross-sectional wooden rods is the following:

a- position and tighten the milling tool steel body *5* between the jaws of a steel vise *4*;

b-the desired diameter of the wooden rod *1* with circular cross-section is fixed. To do this, release the clamping screws *6, 7, 8* and *9*, remove the two cutting knives *10* and *11* and insert a number of spacing plates *12* of different thicknesses between them and the steel body *5* until they are made the desired milling diameter, the knife blades *10* and *11* are mounted and re-tightened. Checking the milling diameter is done with a calibration steel rod;

c- when milling the long wooden rods to prevent their eccentric rotation after the milling operation, the rod guide system consisting of the cylindrical steel rod 18 is used with the guide *19* and two randalinated screws *20* and *21*. Positioning the guide rod *19* on the steel rod *18* is depending on the length of the milled wooden rod;

d-the drive head is assembled by threading a body *13* having the square section value corresponding to the square section of the wooden rod *2*, with a straight back body *15* after which the drive head is engaged in the chuck *16* which is driven by the shaft *17* of manual electric drill and insert wooden rod *2* with square section into the square hole of the body *13*;

e- e- it is positioned the free end of the wooden rod 2 with square section in the area of the cutting blades 10 and 11, the manual electric drill is started and the manual feed of the wood rod 2 is made by the operator to the cutting knives. The feed rate will be between 3 and 6 m/min depending on the nature of the processed wood, the milling diameter, the sharpening condition of the cutting knives and the desired roughness for the resulting cylindrical surface after milling. The longitudinal advance of the square-sectioned wooden rod *2* continues until the chuck 16 of the drilling machine has close proximity to the milling tool steel body 5, then stops the drilling machine and removes the drive head from the drill chuck;

f- the milling end of the wooden rod *1* with circular cross-section in the chuck *17* of the drilling machine is engaged, the drilling machine is started and the longitudinal feed continues until the milling and the end of the square rod *2* are made;

g-for making other cylindrical rods repeat the operations from a point *a* to *f*.

The operator mode for cilindrical limb of the wooden rods ends of square-sectioned is as follows:

h- repeat the operations from a) to b) to specific to the production of circular cross-sectional wood rods;

i- screw the knurled bolt *22* into the steel body *5* to a depth corresponding to the desired length of the cylindrical plug made, then the chuck nut *23* is tighted manually to prevent the bolt *22* being loosened during the clamping operations;

j- the assembly of the drive head is made by threading a body 13 having the square section value corresponding to the square section of the square-sectioned wood rod *3*, with a circular cross-sectional body *14* and then engaging the drive head in the chuck *16* driven by the shaft 17 of manual electric drill and insert a wooden rod *3* with square section into the square hole of the body 13;

k- the free end of the wooden rod *3* with square section is positioned in the area of the cutting blades *10* and *11,* is starting the manual electric drill and the operator performs the manual advance of the wood rod *3* to the cutting knives until the feed is blocked by the end of the feed limit screw *22*;

l- the drilling machine stops, remove the wooden rod *3* from the cutting knives *10* and *11*, extract the wooden rod *3* from the body *13* of square section and insert the other end (in the case of cilidrical limb of both ends of the wooden rod) into the square hole of the drive head body 13 and performs the operations from point *k* and partly those to*1*;

m-for the cilidrical limb of other wooden rods *3* of square section, the operations from point *h* to point *l* are repeated;

2.2. Device for obtaining cylindrical wooden rods of large diameters and long lengths

The device is intended for the revolution milling of square wood rods in order to obtain cylindrical rods used as a raw material for various applications in the furniture industry, wood toy industry, wooden tails for tools and hand tools [9]. In view of the revolution milling of square wooden rods are used millingof two or more knives, wooden semiproduct being pushed to the knives by a feed system with jagged rolls.

Depending on the feed rate, the cutting speed and the quantity of cylindrical wooden rods manufactured, the cutting blades need to be sharpened again for a certain amount of operating time. This leads to additional costs caused by stopping the machine for removing the knifes worn, for mounting the knives resharpened and for centering the knives to a specific diameter of a cylindrical rod which is intended to be obtained. These costs are added those caused by resharpening operation of the knifes.

The technical problem solved by this device lies in the fact that it is equipped with two special cutting knives which, after finding cut edge wear of the cutting edge, rotated each with 90^0, so that after the fourth rotation only their removing and resharpening is necessary. The device is mounted by screwing on the hollow shaft of a wood milling machine by revolution, the milling of wooden rodss with square section in cylindrical wooden rods being made by two bell-type knifes, tightened with a screw on two knife ports rigidized with two other screws on the drum of the device. In order to produce cylindrical rods of various diameters, the knife ports have a dovetail, which can be moved in a channel with the same dovetail tail geometry made in the drum of the device, after the desired diameter has been determined, each type of dovetail is stiffened

in place by the two clamping screws mentioned.

The advantage of the device is to provide between two sharpening an operating life of more than four times the operating time between two conventional cutting blade sharpening.

In the device structure, Fig. 6, there is provided a drum *1* provided with two dovetail channels C1 and C2, two cutters *2* and *3* type bell, Fig.7.a, b, having a cutting angle of 15 ° each provided with four centering orifices A, at 90 ° relative to each other, which can communicate with an O-hole of the same diameter at 90 ° rotation of the bell-type cutter *2*, two knife ports with dovetail sole *4* and *5*, two screws 6 and 7 for clamping the knives on the knife ports, four bolts *8, 9, 10* and *11* for clamping and stiffening the sliding foot on the drum 1 and a guide sleeve 12, Fig. 5c. Reference numeral *13* is a hollow drive shaft of the milling round, reference numeral 14 represents a cylindrical metal gauge for adjusting the diameter of the milling, and reference numeral *15* subjected to the milling wooden semiproduct. The operating mode of a milling machine having the described device is as follows: After fitting the drum *1* by screwing onto the hollow drive shaft *13* of the round milling machine, the four screws *8, 9, 10* and *11* for clamping and stiffening the padded sole are loosened and the bush*12* is threaded to guide the cylindrical wooden rod in drum*1*.After these operations, a metal cylindrical caliber *14* having a diameter equal to the desired diameter of the finished cylindrical wood rod is inserted into the guide bush *12* and the knives *2* and *3* are lowered to the contact with the metal cylindrical caliber generator *14* after which the screws *8, 9, 10* and *11* are tightened, and the guide bush *12* is extracted. It should be noted that in order to prevent excessive friction between the finite wood cylindrical rod and the guide sleeve *12*, the latter has an inner diameter of 1.5 mm larger than the blade diameter of the knife type bell *2* and *3*.

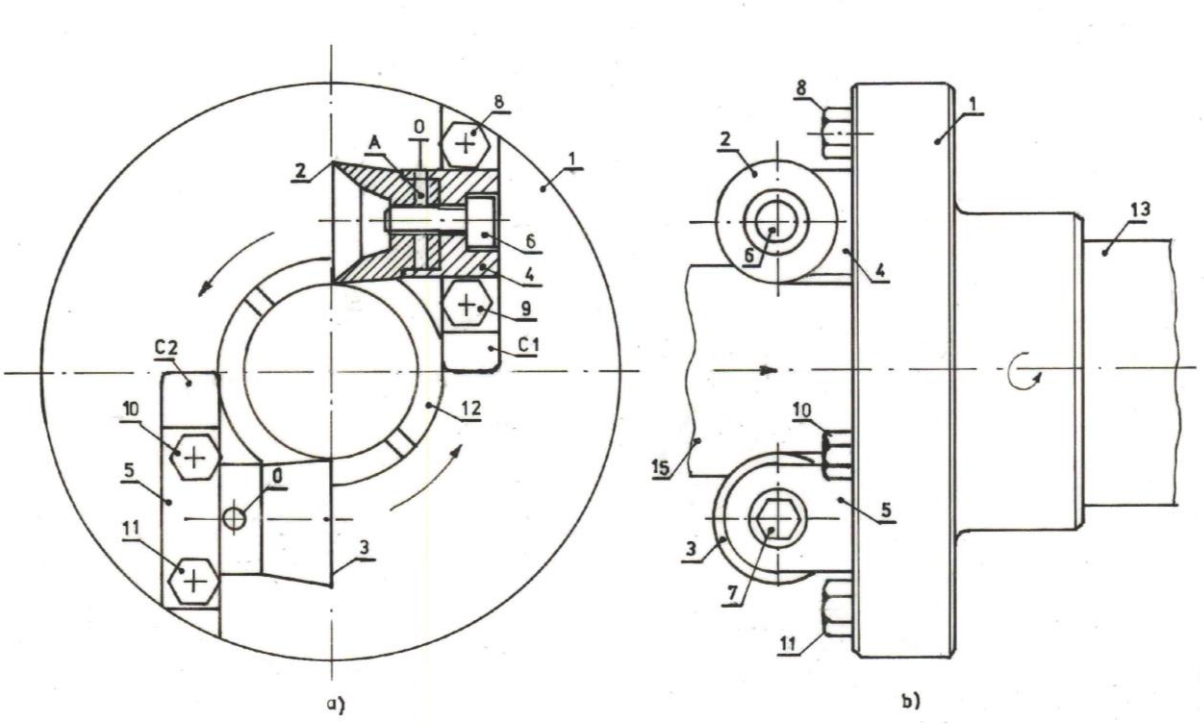

Figure 6. *The front view (a) with a partial section of the round milling device, the side view (b) of the round milling cutter with a partially wooden semifinished product. 1-drum, 2,3-blade cutter bell type, 4,5-port knife, 6,7,8,9,10,11-clamping screws, 12-guide bushing, 13- drive shaft of round milling machine, 14-cylindrical metal caliber, 15-molded wood semifinished, C1, C2-channel type dovetail, A-centering holes, O - hole*

When the cutting quality decreases due to the wear of the cutting edge of the two knifes type bell *2* and *3*, the milling machine stops, first breaks the clamping screw *3* of the knife type bell *2*, turns slightly with approx. 20^0 knife body *2* to the left, insert a metal pin into the centering hole O and continue turning slightly on the left until the metal pin enters the centering hole O and the centering hole A, then tighten the screw *6*, the metal pin is extracted out of the hole O and the operations is repeated in the order described for the knife type bell *3*. It is to be noted that rotating knives *2* and *3* type bell, to renew the cutting edge is always to the left to avoid the worn blade edge of the knifes type bell *2* or *3*, from the contact area with the square section rod, with possible wear traces due to the variable section of the bar, to be found in the final milling area of the finished cylindrical rod. This area represents the finishing segment of the cylindrical rod of the wooden semiproduct *15*, possibly wear marks of the cutter blade in this segment of the knives results in a sensible decrease in the quality of cutting.

A device of the type described can provide, under high-quality cutting conditions, cutting speeds of 3000 rpm and feed rates of the semiproduct about 5-10 m/min, making long cylindrical rods, of diameters ranging from 8-50 mm.

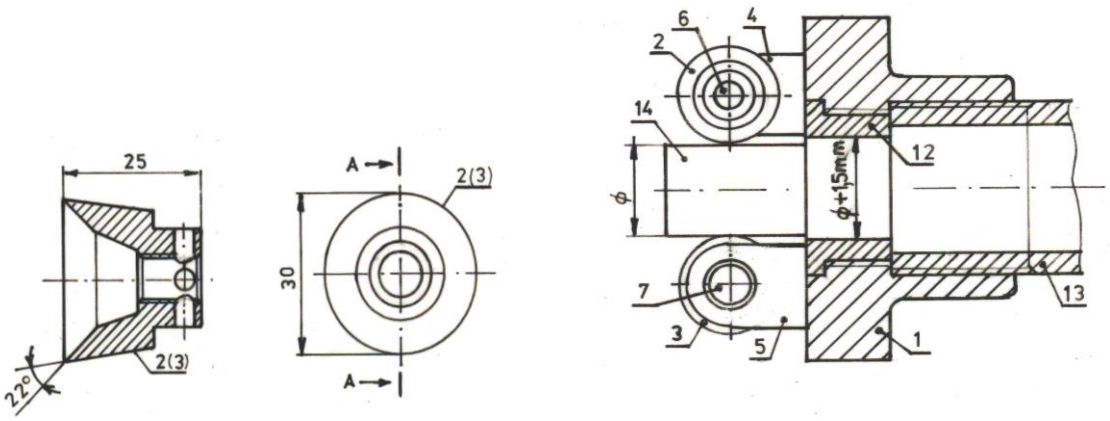

Figure 7. *Front view of bell milling cutter (a) section by bell milling cutter (b), 2 (3) - cutting knife type bell (c) Diagram used for calibration of final cylindrical rod diameter. 1-drum, 2,3- cutting knife type bell, 4,5-knife ports, 6,7, 12-guide bush, 13- drive shaft of round milling machine, 14-metalic cilindrical caliber*

Conclusions

By means of the inventive conceptual and constructive solutions described above, it is possible to produce cylindrical milling devices and cylindrical limb of wooden rods, made of wooden rods with square section, in a large range of diameters and lengths, allowing to meet the needs of the furniture industry, wooden toy industry, carpentry workshops and not the last of the individual households.

Acknowledgments

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