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ASPECTS REGARDING THE STUDIES THE CHAINS OF SIZES THAT THEMSELVES FORMED IN THE CASE OF DEVICES OF ASSEMBLY

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Abstract— In this paper are presented and studied the chains of size that himself form to the automatic assembling of parts of the rotation. The assembling the parts are made with centering rods, prisms fixed and prisms mobile. The position of the assembled parts will be determined by the shortest chain of size and the influence of rotations relative on the precision of coincidence of the parts that themselves touch will be practically excluded.

***Keywords*:** chain of sizes, devices assembly, tolerance

I. INTRODUCTION

The importance of studying chains of sizes is present and in the case's designing, installation and functioning of the joining devices. These chains dimensions are seen as some spatial chains of sizes. Spatial chains of sizes represents the technical device which the quotas an assembly it transforms succesive at subassemblies and parts so as to enable achieving the initial conditions of parts and intermediate conditions of subassemblies [1] - [2].

A classification a the chains of size encountered in the specialty literature is it after membership at piece or at ensemble. Here it can distinguish two types of chains of sizes, namely: chains dimensions of the parts taken individually – these chains of sizes determines partially or totally, the size, shape and position of surfaces of a piece (these chains of sizes are obtained at the processing) and chains of sizes at assembly (obtained at the assembly) [3]. The chains of sizes of assembly determined, in part or in whole, the position of parts in an assembly, these are divided into: the chains of sizes of assembly determined, in part or in whole, the position of parts in an assembly, these are divided into (for example, realization of the assembly of the shaft-bore with game or with tightening, and refers to the chain of dimensions of assembly formed only of two parts; realization to a three-jaw chuck and refers to the chains of sizes of the assembly formed of several pieces) and chains of sizes of liaison that are encountered in presenting the dimensions between subassemblies of the car [4] - [5]. For this reason, in this work are shown various devices for the assembly of pieces of revolution (shaft, bushes etc.) as well as the chains of size what is formed in the case of schemes of attachment and their orientation. The pieces assembly are made with the aid the rods of centering, prisms fixed and prisms mobile, in the work being presented the scheme of fixing and guidance to the shaft and the bushing at automated assembly on horizontal. The study the chains of size, that themselves form at the automated assembly of different parts, is needed as it helps to choose the shortest path of assembly and the increase or decrease tolerance of sizes of the device of orientation and fixation of various parts used at the assembly devices [6].

II. REGARDING FORMING CHAINS OF SIZE AT DEVICES OF ASSEMBLING PIECES OF REVOLUTION

During the moment of assembly between the a shaft and a bushing, Fig. 1, the forces which enter in action can be expressed in function of:

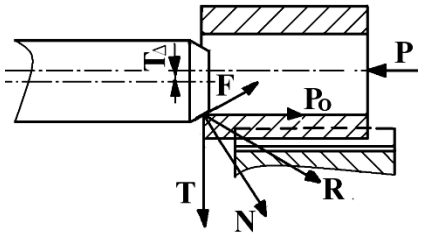

Fig. 1. The forces that occur during the moment of the assembly.

$$P \geq T + G\,tg(\varphi + \rho) + \mu G \quad (1)$$

where: P is the force of assembly;
T – the pressing force of the edge;
G – force of gravity of the bushing;
φ - edge angle of the shaft;
ρ – the friction angle;

μ - the coefficient of friction.

During the joint, the bushing slides with her edge on chamfer of shaft, and the prism pressed with force P until generator surfaces of shaft coincides with those of bushing. During the sliding, assembly force reaches a maximum, and then decreases rapidly. The amount of force F is directly proportional to the error of the orientation and inversely proportional to the size of the pressing force P of the mechanism of the prism. From the formula represented above is observed that when known quantities G, μ and F is easy to determine the force of pressing on the prism.

A device for orienting and fixing the cylindrical parts which are to be assembled, it is shown in Fig. 2. In this case the accuracy of the relative position of the parts assembled is influencing the degree of coincidence, deviations the shaft and respectively deviations the centering rod.

At the automatically installing in cases where the the pieces that themselves touch on the cylindrical surfaces, and they are chamfers of very small size, is will maybe used as orientation element and fastening element, the prism fixed or movable, which makes it possible to completely exclude the unwanted deformations of pieces and some deteriorations of surfaces. By presenting chains of sizes (linear, angular) wich is formed, it can determine the precision of the coaxial parts which are assembled as well as the precision their spins.

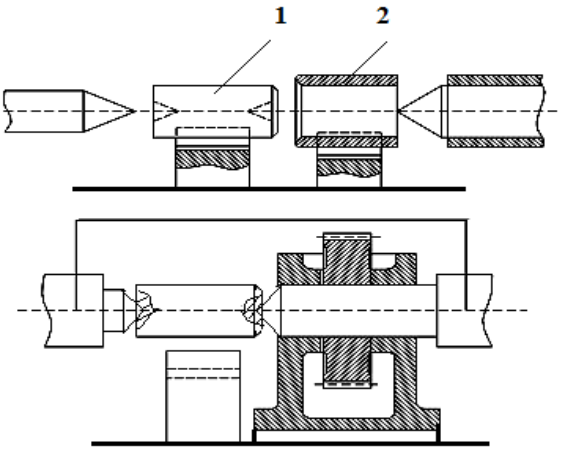

Fig. 2. The schemes of orientation and fixation of pieces assembled with help the centering rods.

The position the assembled pieces will be determined by the shortest chain of size, and the influence the rotations relative on the precision of coincidence a the pieces, that themselves touch will be practically excluded. In this case, the diameter of the centering rod is given by the relation:

$$d_t \leq d_0 \quad \frac{d_0 \quad d}{2} + c_1 + c_2 \tag{2}$$

When using the such a device, the precision of coincidence of the pieces that will assemble will be determined by the shortest chain of size. A necessary condition to the attachment pieces in such devices is the presence the holes of centering at the shaft that is to be assembled.

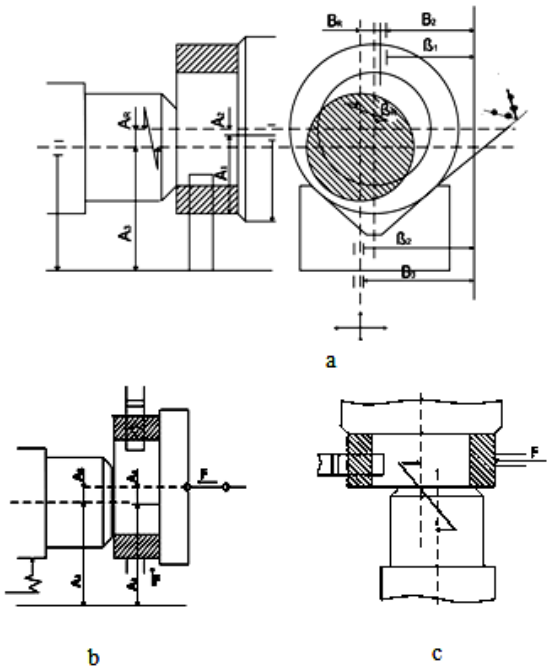

Fig.3. The position the assembled pieces, in the case when you the report l / d> 1.

In the case these devices, the report the length of the sleeve as against the inside diameter is l/d>1, and in that case, the materialization the base of touch to pieces themselves can present in the form of schemes, Fig. 3 a,b and c, where the support points are materialized on the edge of the punch, respectively on the prismatic support which is located in the bottom of the device. (Fig. 3 – a,b) and 2-bor on part lateral (Fig.3 -c).

The determination the chains of size themselves make with the relations:

$$\begin{aligned} A_R &= A_1 + A_2 \quad A_3 \\ B_R &= B_3 \quad A_2 \quad A_3 \\ \alpha_R &= \alpha_1 \quad \alpha_2 \\ \beta_R &= \beta_2 \quad \beta_1 \end{aligned} \tag{3}$$

In Fig. 4 is presented the scheme of orientation and of fixation at the fitting the block the chain of roller. In this case non coincidence between of the holes in plate and bushings, it will determine with the chain of size:

$$A_R = A_1 \quad A_2 \tag{4}$$

and $T_{A_R} = T_{A_1} + T_{A_2}$ - represent the tolerance between the holes in plate and bushing.

The rod's diameter is given by relation:

$$d_t = d_o \quad T_{A_R} \tag{5}$$

$$T_{A_R} = T_{A_1} + T_{A_2} = \frac{d_{0\,max} \quad d_t}{2} + e_b \qquad (6)$$

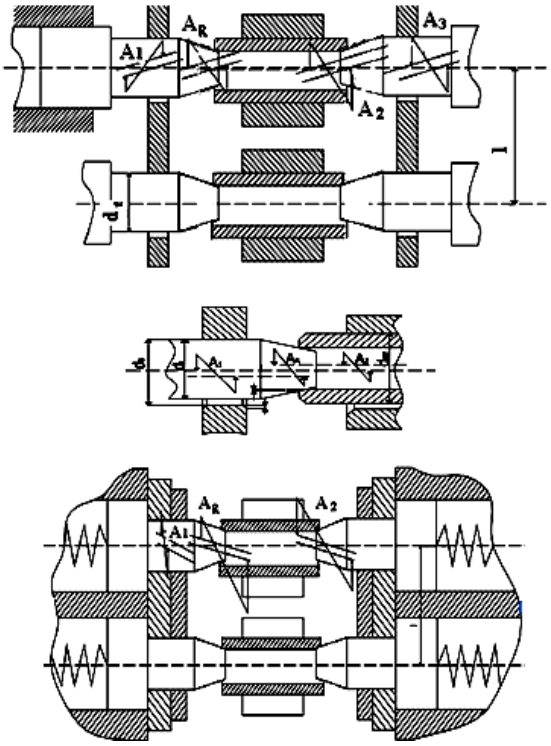

Fig. 4. Scheme of orientation and of fixation at the fitting the block the chain of roller

For the contact between plates holes and bushing must respect the condition:

$$T\Delta_{\sum} = T_{A_R} = T_{A_1} + T_{A_2} = \frac{d_{0\,max} \quad d_t}{2} + e_b \leq \leq \frac{d_0 \quad d_b}{2} + c_1 + c_2 \qquad (7)$$

The study the chain of size A, B, α and β which themselves determined by the position of pieces in contact is easy to observe that the position of the bushing compared to the shaft, are influencing widening the bushing, the errors outer surfaces of bushing and of shaft, perpendicularity the edges pieces compared to their axes.

For parts that are assembled with the game, without sharp edges beveled, in the absence of the coincidence of the edges of the contact surfaces, it obtain a rigid closing force, and at increase the assembly forces can take place the crushing or cutting edges, after which the assembly force disappears quickly.

Are further presented modes of assembly of cylindrical parts (the assembly between the shaft and the bushing), modes of orientation and fixation of their in the special devices and calculating the chains of sizes which it form during assembly. In Fig. 5 is presented a schematic of orientation and fixation of the shaft respectively bushing at the automatic assembling on horizontal. Also are shown and the chains of sizes which it form: A, B, α and β. By those chains of sizes (as we said) it can determine the precision of the coaxial parts which are assembled as well as the precision their spins.

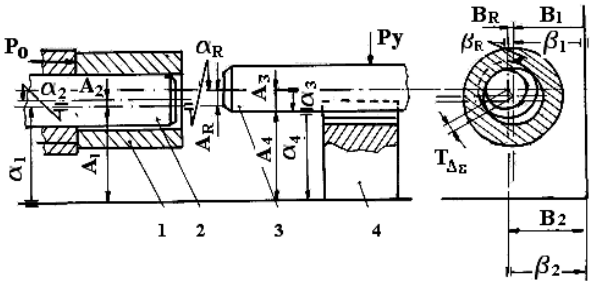

Fig. 5. The scheme of orientation and fixation the shaft and the bushing at the automatic assembly in the horizontal plan and presentation the chains of sizes A,B, α, β which it form.

In this case, we have:

$$A_R = A_4 + A_5 + A_6 \quad A_1 \quad A_2 \quad A_3; \qquad (8)$$

$$B_R = B_2 \quad B_1; \qquad (9)$$

Tolerances the resulting elements are given by the relations:

$$T_{A_R} = \frac{T_{D_B}}{2} + l_1 + \frac{d_0 \quad d_B}{2} + T_{A_3} + l_2; \qquad (10)$$

$$T_{B_R} = T_{B1} + T_{B2}; \qquad (11)$$

The tolerance $T_{\Delta_\sum}$ is determinate with relation [7]:

$$T_{\Delta\,\sum} = \sqrt{\frac{T_{D_B}}{2} + l_1 + \frac{d_0 \quad d_B}{2} + T_{A_3} + l_2 \quad ^2 + \left(T_{B_1} + T_{B_2}\right)^2} \qquad (12)$$

$$\Delta_E = \Delta_{min} + T\Delta_\varepsilon; \qquad (13)$$

In this case, rod diameter will be given by:

$$d_t = d_{0min} \quad (\Delta_{min} \quad T\Delta_\varepsilon) \qquad (14)$$

where: T_{d_B} it is the tolerance the shaft diameter;

D_{01}, D_{02} - the diameters of the holes corresponding the bushing and the shaft;

T_{D_B} - the tolerance of the outer diameter of the bush;

$T_{A_3}, T_{A_4}, T_{B_3}, T_{B_4}$ - tolerances the basic elements;

e - the size of concentricity of the bushing.

Because the axis of the shaft coincides with the axis of the bushing is necessary for the bushing to be displaced and to be able to rotate within the tightening, and for this thing the diameter rod of centering d_t must shall be less than the hole diameter bushing:

$$d_t \leq d_{0\,min} \quad \Delta_{min} + T\Delta_{\Sigma} \qquad (15)$$

When at assembling, generators surfaces the shaft coincide with those of bushing, the latter will be fixed, oriented and centered with help the centering rod whose diameter is determined by the relationship 15.

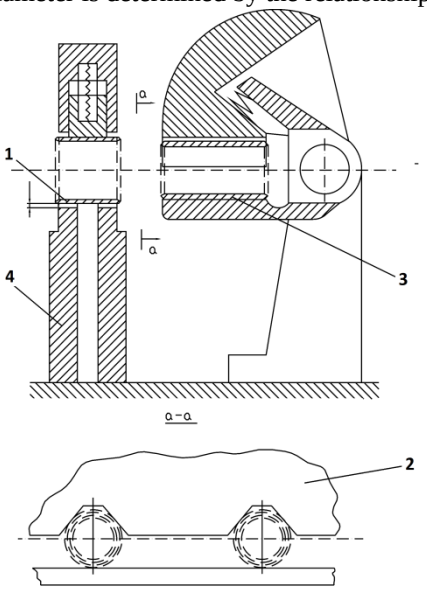

Fig. 6. Mounting of a bush and a piece of type roll: the case in wich the prism of fixation is located in the upper.

At the automated assembly the bushing 3 with the roller 1 (Fig. 7) the scheme of orientation and fixing is similar to that of Fig.6 and Fig.7, which is why diameter the rod of centering is determined with same relationship of calulation 15.

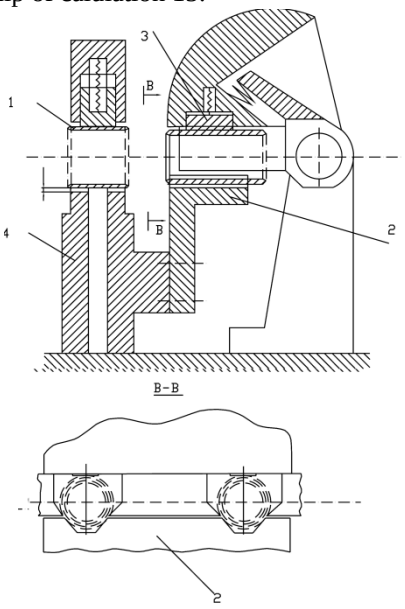

Fig. 7. Mounting of a bush and a piece of type roll: the case in wich the prism of fixation is located in the lower.

From the foregoing, it can be pointed out that the greatest weight at the automated assembly of parts with cylindrical surfaces consists in the overlapping of surfaces with very small sizes of the games due the chamfers.

III. Conclusion

From analysis the schemes of guidance and of:

a. fixing studied is resulting that: the contact between surfaces of parts assembled themselves make on the shortest path, by determining the shortest chain of size, excluding the influence of the errors elements of initial support, the center itself in such cases will play the seeker role which orients and is fixes the pieces on their surfaces of contact;

b. the assembly process can be studied as a problem of surface whose solution aims at achieving coincidence the surfaces pieces which themselves assemble and the position of reporting their.

The use the shortest path to the assembly allows to increase tolerance at the dimensions devices of orientation and fixation of the machine of assembled, tolerance which enter in the calculation the chains of sizes.

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