CHARACTERISTICS OF MICRO PROCESSING BY USING OF THE ULTRASOUNDS

Lăcrămioara APETREI[1], **Laurenţiu SLĂTINEANU**[2], **Adriana CRUPA**[3], **Oana DODUN**[4], **Traian GRAMESCU**[5]

ABSTRACT:

The ultrasonic technology is indicated in the situations when we can obtain a superior technical and economic efficiency rather that specific to others non-traditional or conventional processing methods. Both in the country and aboard many knowledge concerning the micro technology using ultrasonic are gathered. In this paper some characteristics of the micro technology using ultrasonic are analyzed. The existence of an ultrasonic in the Department of Machine Manufacturing Technology of the "Gh. Asachi" Technology University Iaşi created conditions to perform some researches regard the capabilities to apply some micro technologies.

KEYWORDS: Ultrasounds, Microprocessing, System for workpieces clamping, System for working motion

1. INTRODUCTION

The processing by using of the ultrasounds applies the effects generated by the presence of vibrations with high frequency *f* (more than 20 KHz) [9].

Once discovered enough powerful ultrasound vibrations generators, the machining processes by using of ultrasounds and machining equipments were developed. Thus, the so-called abrasive-cavitational or simply cavitational machining techniques and techniques based on the presence of vibrations with ultrasound frequency in the frame of different traditional machining methods appeared.

The timely tendency of evolution of the research in this field is directed to the machining conditions optimizations and to the extension of the machining by using of ultrasounds vibration area [1, 2, 3, 4, 5, 6, 7, 8].

In our country Şerban Nanu made a large research regarding the aluminum sheet pressure welding in ultrasound field (1985).

In the world, a tendency of designing and performing of complex equipments for machining by using of the ultrasounds could be remarked. The using of some new methods for studying and modeling phenomena specific to the machining processes by applying of the ultrasounds was also noticed.

Another tendency approached in the specialty literature study regards the using of the ultrasounds in the frame of some micromachining techniques.

2. DRILLING AND WELDING MICRO PROCESSES BY USING OF THE ULTRASOUNDS

In the Department of Machine Manufacturing Technology of the "Gh. Asachi" Technology University from Iaşi, a machine for ultrasounds processing exists; taking into consideration the existence of this machine, the problem of designing and building of some devices to allow the drilling and welding micro processes appeared.

One variant of a device used firstly for mould material small dimensions pieces welding is presented in the figure number 1. We took in to consideration the possibility to perform a table which allows the materialization of the pressure necessary to the welding by means of a spring. For this purpose a table 13, offered by the machine tool builder was used. We added to this table some components so that we could assure the relative pressure necessary between the tool and the workpieces. We mention that the machine

tool is endowed with a lever to manually perform the work motion, but the existence of relatively big friction forces in the mechanisms for work transmitting from the lever determined us to take also into consideration other variants to obtain the relative pressure between tool (or the assembly in an one piece horn - tool) and

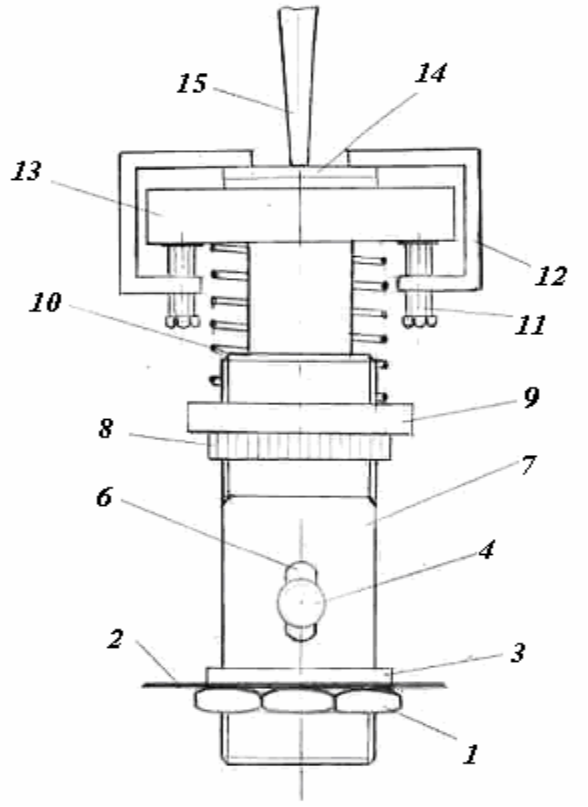

Fig. 1. Schema of the ultrasonic microwelding

workpiece.

The table 13 of the device for sustaining the workpieces is assembled with the machine tool table by means of a disk plate 3 and of a nut 1, which could be screwed on the inferior part of a sleeve 7. The bar of the table 13 can glide in the sleeve 7. We introduce the sleeve 7 in the special orifice perform in the machine tool table and we fixed vertically moving the thread zone of the nut 1.

In the middle zone of sleeve 7 an oval orifice exist; through this orifice a screw 4 penetrates and fixes the bar of the table 13 in a certain position. The clamping is necessary to maintain the position of the bar when the work motion is perform by the work piece. If the work motion is perform by the tool the clamping by means of the screw 4 does not permit the rotation of the table 13 (on this table the workpieces to be welded are placed).

The superior part of the sleeve 7 is also threaded; thus, we can move the nut 8 along it. The table motion is performed by means of a spring 10; the length of the spring changes and thus a modifying of the pressure force appear. If in the case of micro welding we have not a significant change of the horn positions during the machining process, for other techniques a careful analyze of the pressure force modifying simultaneously with the change of the spring length is necessary.

Between the nut 8 and the spring 10 o disk plate 9 is placed to protect the nut against the wear.

The workpieces are clamped on the table by means of the bridle and screws.

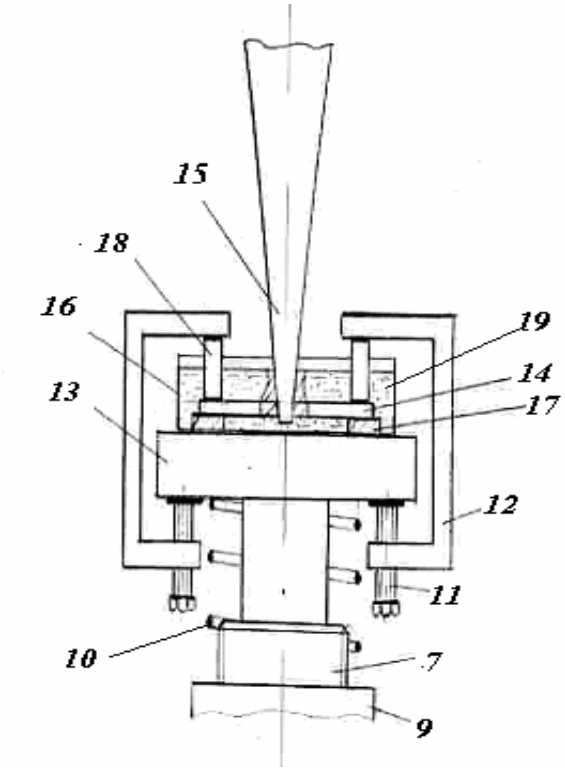

Fig. 2. Schema of microdrilling

The machining schema from the figure2 corresponds to a microdrilling.

The subassembly that assures the performing of the work motion by the workpiece is similar to that presented in figure 1. On the work table 13, a recipient with the solution that

contains abrasive granules in suspension is placed. Because we must perform a

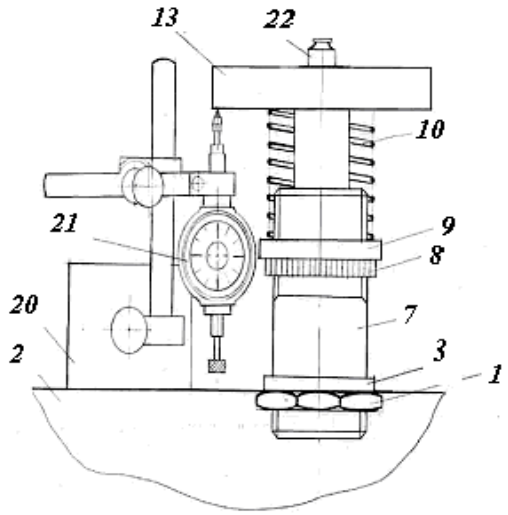

Fig. 3. Establishing of the correlation between the table displacement and the force exerted by the spring

microdrilling the workpiece is fixed on a disk plate 17.

Taking into considerations economical aspects for the workpieces clamping, the same bridles and screws like those from the figure 1 are used. The workpiece is clamped between the disk plate 17 and two parallelepiped pieces18, which assure the contact with the two bridles.

The material removing is due to the combined action of four mechanisms:

- microcutting generated by the impact of the abrasive particles (vibrating with aqueous solutions) with workpiece surfaces;
- microcraking generated by the impact of the free abrasive particles with the machine surfaces;
- cavitational phenomenon;
- eventual chemical action of the used fluid.

The main variables which influence the machining efficiency, and on the other hand the surface roughness and accuracy, are the following:

- the amplitude of the tool oscillations;
- the impact force;
- the dimensions of the abrasive particles.

The above described system could be used for all the micromachining methods, but also for machining techniques that need bigger forces than those specific to the micromachining methods. In the second case the bridles and the parallelepiped pieces could constitute a single piece, to avoid the clamping and orienting errors.

To establish a correspondence between the contact pressure and the spring length, we placed weights of known sizes on the table 13 and measured the table displacement. In figure 3 we could see the manner in witch we performed the positioning of a dial gauge to monitor the table displacement. A magnetic support was used to place the dial gauge on the table of the ultrasonic machine. The sensor of the dial gauge takes contact with inferior surface of the work table and thus, placing the weights, we can measure the table displacement. We obtain the data presented in table 1.

Table 1 Experimental data

Nr.	M, g	Δ_1, mm	Δ_2, mm	$(\Delta_1+\Delta_2)/2$, mm
1	100	0.20	0.25	0.225
2	200	0.94	1.01	0.975
3	300	1.75	1.73	1.74
4	385	2.47	2.35	2.41
5	460	3.10	2.94	3.02
6	535	3.69	3.60	3.645
7	610	4.10	4.21	4.155
8	810	5.60	5.57	5.585

The processing of the numerical data included in table 1 by means of specialized software (based on the applying of the smallest squares method) led us to a function type power, which establishes the correspondence between the decreasing of the spring length and the masses *G* of the weights used during the calibrating action:

$$\Delta = -0.622047888.196\cdot10^{-3}\cdot G - 6.271\cdot10^{-7}\cdot G^2 \quad (1)$$

An image concerning the adequacy of this mathematical model to the experimental data is offered by the so-called Gauss sum; In the case of the function represented by the relation 1, the Gauss sum is: $S = 1{,}04172\cdot10^{-3}$

3. CONCLUSIONS

The study of the specialty literature emphasized the existence of some

possibilities to use microsounds for micro welding or micro drilling. The presence of an ultrasonic machine in the Laboratory of Non-traditional Technologies of the "Gh. Asachi" Technical University from Iaşi permitted us to exam the possibilities to perform micoprocessing on this machine. We considered that we could use the machine for micro welding and microdrilling.

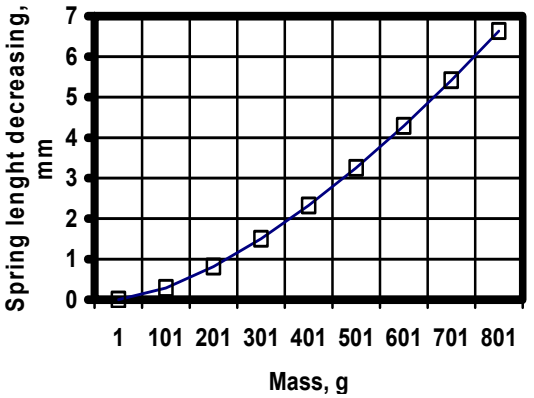

Fig. 4. Deformation of the spring under the action of some known weights

Because the machine tool was not endowed with adequate solutions for workpieces orienting and clamping we analyzed some possibilities to design and perform devices usable for this purpose. Two devices for microwelding and microdrilling were built and tested.

Economical considerations determined us to use common components for the two devices. The work motion was performed by means of a spring. Because in this cause simultaneously with the increasing of the stroke work length a modifying of the contact pressure between the tool and the workpiece can happen we established a correspondence between the force exerted by the spring and the changing of its length.

In the future we will take in to consideration the performing of experimental researches concerning the study of the influence exerted by different factors on the resistance of the welded joints between workpieces of mould materials and, respectively, the evaluation of the possibilities to obtain small diameters holes by ultrasonic machining.

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AUTHORS

[1] Lăcrămioara APETREI, Technical University "Gh. Asachi" of Iaşi, Romania, e-mail: apetreil@yahoo.com,

[2] Professor, Ph.D, eng. Laurenţiu SLĂTINEANU, Technical University "Gh. Asachi" of Iaşi, Romania, e-mail: slati@tcm.tuiasi.ro,

[3] Adriana CRUPA, Technical University "Gh. Asachi" of Iaşi, Romania, e-mail: adycypmunteanu@yahoo.com,

[4] Associate Professor, Ph.D, eng. Oana DODUN, Technical University "Gh. Asachi" of Iaşi, Romania, e-mail: oanad@tcm.tuiasi.ro,

[5] Professor, Ph.D, eng. Traian GRĂMESCU, Technical University "Gh. Asachi" of Iaşi, Romania, e-mail: grat@tcm.tuiasi.ro,