

# Development and Research the Device of Transmission Electrical Power at Gyrating Piezoelectric Transducers electrodes

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**Abstract.** The ultrasonic processing has the certain restriction- decline of productivity when increasing the depth of processing. The giving to the working tool in addition to oscillatory, rotary movement, that will increase productivity of processing in this article the way of inductive energy transmission on gyrating piezoelectric transducers electrodes is offered.

## I. Introduction

The very high extent in fragility of many natural and artificial ceramic materials hinders and/or eliminates their machining, in particular: when grooving and through holing of a necessary diameter or form. It is known that in order to process fragile and hard materials the special ways - electrochemical, electroerosive, electron-beam, ultrasonic and other are developed. The ultrasonic way of dimensional processing is most effective and simple in this implementation.

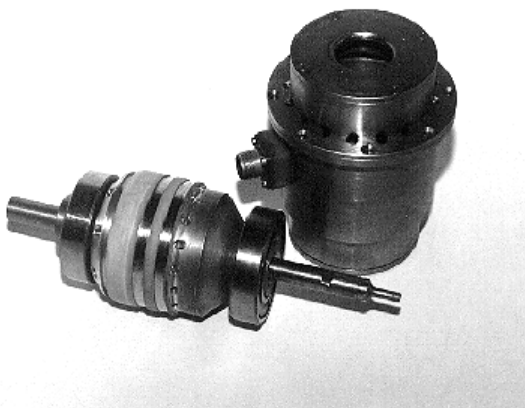
## II. Problem Description

The ultrasonic processing has the certain restriction - decline of productivity when increasing the depth of processing.

There are two ways of a solution that problem exist:

- The first way is regulation the output power of the generator while increasing the depth of processing. The following by that way conducts to complicating construction of the generator and rise in price of all ultrasonic equipment. The output power of the generator is limited magnitude and the deep orifices drilling (more than 40 mm) reduces the productivity of drilling.

- The second way is a giving to the working tool in addition to oscillatory, rotary movement, that will reduce surface friction of the working tool, and also supply circulation of abrasive suspension in the processing zone.



To fulfil the ultrasonic drilling with the rotation working tool, created an experimental construction, contains brush collector submitted on photo. 1.

The system increasing efficiency of processing, the experiment results are represented in table 1.

Photo 1 – Rotation system with brush collector

Table 1. Experiment results

Rotation Speed	Drilling of glass productivity			Average productivity
	3 mm	4 mm	5 mm	
RPM				mm/min
0	3.2	3.0	2.8	3.0

300	4.9	3.3	3.0	3.7
1500	6.9	5.0	4.0	5.3
3000	7.5	6.2	5.4	6.4

The oscillatory system works at the resonance and on it electrodes there is a high voltage, about 1 - 2 kV. Therefore high-reliable electrical contact between electrodes of an oscillatory system and feeding cable is needed that is not always possible on rotation oscillatory system.

During drilling with stationary oscillatory system, the current through a force transistor, represents an ideal half-sinusoid.

During drilling with rotation, the significant distortion of the current form was observed, that unfavourably has effect for work of the generator.

It is necessary to investigate work of the brush collector.

To fulfil the experiments the measuring circuit was assembled (fig. 1.)

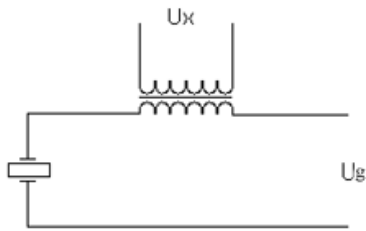


Fig.1 – Measuring circuit

Capture of a signal ( $U_x$ ) provided by 16-digit ADC (Sound Blaster), at sampling rate 48kHz in to the WAVE-file. File was treated by *Cool Edit Pro* software.

The obtained outcomes submitted on Fig. 2

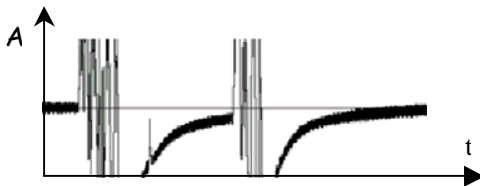


Fig. 2 – Pulsing of current

The pulsing of current is visible (fig 2). It is a kind of transient of switching, i.e. brush collector does not provide necessary contact.

### III. Inductive transmission of ultrasonic energy

Thus, it is necessary to work up the devise of rotation oscillatory system. The devise should transmit an electrical signal with a smaller distortion and, it is desirable to be structurally simpler.

Two variants of rotated oscillatory system were offered:

- The oscillatory system makes rotating oscillations simultaneously with longitudinal. This method is not acceptable, because the experiments with a brush collector devise obviously show increasing of productivity of drilling, while increasing the rotation speed.

- Rotation system with application of gyrating transformer. Application of an inductive way of energy transmission.

The developed and assembled rotation system submitted on fig. 3.

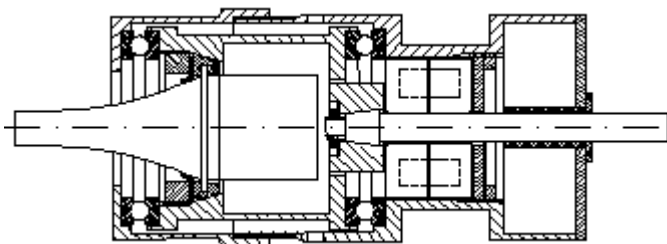


Fig. 3 – Rotation system with gyrating transformer

The measurements of the form of current, which flowing through a force transistors submitted on fig. 4.

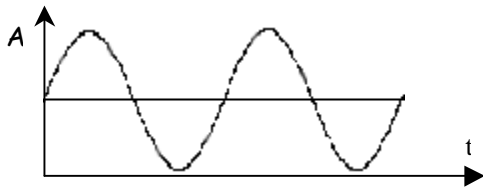


Fig. 4 – Form of current flowing through a forcetransistors

The obtained data testify that the form of a current of the generator, flowing through a force transistor, represents an ideal sinusoid. Thus, the transmission of an electrical signal on electrodes of gyrating piezoelectric transducers transmitted without distortions.

#### IV. Conclusion

The created devise of rotation with gyrating transformer (photo 2) allows to transmit an electrical signal of high frequency (22 kHz) and large amplitude (more 1 kV).



Photo 2 – Rotation system with gyrating transformer

The experimental researches indicating efficiency of application gyrating transformer for ultrasonic processing of fragile and hard materials by gyrating working tool.