REMEMBER NONCONVENTIONAL TECHNOLOGIES DEVELOPMENT

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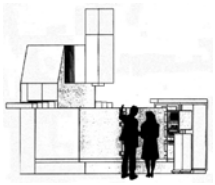

The process of goods production from any field of human activity supposes a series of transformation, and before that, of rough materials, in according to proposed goal, and to materials nature, as well as in agreement with their machining potential at a certain moment of time.

The continuous and parallel development of design and technology made these two important forms of human creative activities – the conception of new products and their physical achievement – to be interdependent and to be progressively improved.

The technologies of mechanical machining, and let's refer only to those of material removal, have a decisive importance, extremely restrictive on design process through the fact that the possibilities of physical achievement were limited to those of classical cutting. Although the cutting processes were continuously developed, their using is in many cases restraining.

The causes that determine this process are diverse:

1. The necessity of materials consuming decrease led to design such products which have lower dimensions, keeping or even increasing their mechanical resistance. This thing supposes new directions of action, namely promotion of some materials with mechanical resistance enhancement, decrease of loaded sections, and increase of parts shapes complexity.

2. New products are developed and correspondingly new industries, referring only some of them i.e., space industry, automotive, micro-electronics, military, nuclear etc. These products are different through their complexity and most of all, through specific materials.

For example, in spatial technique, high mechanical and thermal resistance alloys are mostly used like those based on titanium. In nuclear technique, as in case of nuclear power plants, strong materials are used alloyed with tough metals and corrosion resistant (chrome, tungsten, titanium). Nowadays, in automotive industry, ceramic or composite materials are used, in electronics, semiconductor materials (silicon, germanium) and many others.

The common characteristic of these materials is the weak machinability through cutting. This is displayed by high values of cutting forces, low quality of machined surfaces, excessive wear of cutting tools, low dimensional precision, and intricate kinematics of machines-tools.

If one considers that the parts from mentioned above fields are complicated concerning the shape, and are achieved from materials hardly to be machined, then the nature and size of barriers that have to be exceeded can easily be figured out at machining. This fact limits the product design itself, because the constructor has to take into account the achievement possibilities of respective product and is constrained many times, to adopt a designed variant under the needed level, but which could be technologically achieved.

3. The kinematics of surfaces generation is much complicated at complex shape parts. It is known that cutting operation supposes a relative movement between tool and workpiece not only for progressively achievement of the part, but also due to material removal process, namely chips removal in this case. These two requirements impose rigorous correlated movements at machine-tool, generation movements, whose precision affects the shape and largely, dimensional precision of the obtained part.

4. The construction of the tool, understanding by this generic term all the qualities that must be fulfilled by the cutting tool, is critical determined by cutting process itself as well as by the material and part configuration.

Is there a solution to these problems? One is that of so-called Nonconventional Technologies. Let's see underneath how researches were deployed in the field of physical phenomena of machining, technology and construction of dedicated machine-tool. For exemplification, the machining evolution of electrical discharge machining is addressed.

The use of electrical discharges effect, which in fact were known long time ago, was initiated before the World War II, more precise, in 1937, by Russian scientists Boris and Natalie Lazarenko from the institute of electro technical researches in Moscow. Studying the destroying effect of electrical discharges on electric equipment contacts, they imagined the inverse situation, that of intensifying this effect, transforming it in machining.

The researches were interrupted by the war and after 1950 were resumed by other researchers, in Switzerland this time, who had the initiative of building some machines based on this effect at the beginning of years 50's.

Although the technological aspects were not so good clarified, machines have already constructed in many European countries: Switzerland, Czehoslovakia, Hungary, Germany, Russia and later Romania (in years 70's) and Spain. The machines construction overtook the phenomena and technologic research, in order to conquer as urgent as possible the markets.

The researches concerning technology and physical aspects of the process have begun, emerging a whole pleiad of researches who became later resonance names in the field. In Russia, it could be mentioned *Lazarenko, Mandelstom* and *Rajski, Zingerman, Livşiţ,* in Germany, *Hinnuber, Opitz, Konnig, Schierholt, Kracht, Kurr*, *Barz,* in Israel, *Wertheim,* in Great Britain, *Divers* and the list could be continued with many other names. In our country, it can be cited, without closing the list *Gavrilaş, Ghiculescu, Isarie, Jitianu, Marinescu*, *A. Nanu and D. Nanu, Nichici, Oprean, Popovici*, *Sporea*, *Vişan and others from ICTCM, ICPE,* as well as the author of the present paper. The studies carried on are diverse; the aspects related to phenomena and technology or specific construction of machines were approached.

The high speed of this machining type spreading is confirmed by the great number of companies producing machines for EDM. The first machines from this category were achieved in Switzerland by Charmilles Company from Geneva. They were equipped with relaxation generators and had rather modest parameters. A similar machine of the mentioned above ones was manufactured at the beginning of 5th decade in Hungary at Csepel Company from Budapest. It was called Erozimat U. In short time, such machines were manufactured at AGIE Lausanne in Switzerland, at Nassovia-Krupp Company from Frankfurt and at the firms AEG and Siemens from Germany, at VJK Company in Czehoslovakia and many others. In USA, the ONA Company with its branch from Spain, performing machines were achieved very well appreciated, as well as at JAPAX company from Japan. In the former USSR, many electrical discharge machines were produced, some of them equipped with electromechanical generators, which assured a extremely high speed of erosion at very reduced quality of surface. Beginning with years 60's, the machines manufactured by all companies were equipped with performing generators, using commanded pulses.

In our country, the first machine of this type which was achieved, MEE 01, built in the frame of a doctoral thesis, developed at the chair of Machines-Tools (Machines Building Technology – TCM, Romanian abbreviation - at that time) in 1967. That machine was equipped with a generator with commanded pulses, based on electronic tubes of high power. The second machine - MEE 02 – achieved at the same chair, that time equipped with a generator based on semiconductors devices, was setup in 1975. In the end, at the same chair in 1979, another machine was designed and built, dedicated to broken tools extracting, ELER SD, patented in 1982.

At Electrotimiş Enterprise from Timişoara, the first Romanian electrical discharge machine ELER 01 was introduced in series of fabrication. At achievement of this first type of machine, an outstanding contribution was brought by Romanian researches institutes, ICTCM Bucharest and ICPE Bucharest (through direct participation of the researcher, Gh. Jitianu). In very short time, the Electrotimiş Enterprise managed to diversify the production, achieving several size-types from ELER series, and even a machine with wire electrode-tool - ELEROFIL. Generators which equipped those machines manufactured at Timişoara were conceived and built at ICPE Bucharest. The large number of machines types produced by the enterprise from Timişoara, and moreover the size of the series, made from Romania an important producer of electrical discharge machines in Europe.

Even recently, at Timişoara, electrical discharge machines are built in a Romanian- Italian company, STIMEL, namely in two variants of massive electrode machine, STIMEM 25, and STIMEM 50, as well as wire electrode machine, STIMEFIL 10. All are equipped with generators of Italian fabrication.

Researches in technology were directed in parallel with equipment construction, so the latter taking in their construction, all notable accomplishments emerging in technological researches. Step by step, the generators became more complicated in order to attain the imposed parameters: discharge currents greater and greater, tension pulses able to initiate the discharge channel, short-circuits monitoring, complex systems of dielectric recirculation and many other novelties, intended, as it was presented above, to grow generator efficiency in the first row, and of the machine assembly. Together with IT&C development, its specific elements were inserted in the "brain" of electrical discharge machines, aiming at their optimization.

The development of these researches determined the emergence of very performing machines. Thus, electrical discharge machines were considered specific to toolrooms even not so much time ago, especially for hot sectors. From years '90, the new trend is more and more visible, the use of such machines at series fabrication. Therefore, well known companies in the world like General Electric from United States, Hitachi from Japan, as well as firms from Europe created whole production halls provided with electrical discharge machines. Even flexible production lines were created, especially with wire electrode machines, due to the possibilities offered in automation direction, and because they are provided with specialized computers or PCs.

The phenomenology research is much slowed by the intimacy of physical process of discharge, mainly in the case of very short durations of these discharges. Even so, many researches can be mentioned in this field.
It is very important to mention that beside electrical discharge machining (EDM), other types of machining were developed, like electrochemical machining (ECM), ultrasonic, laser beam, plasma machining etc., fields that were approached by many researchers from Romania and abroad.

Maybe the most significant moment was the one organized in 1971 by Prof. Aurel Nanu, the first Conference for Nonconventional Technologies and later in 1991, Romanian Association for Nonconventional Technologies (ARTN, Romanian abbreviation); both actions are due to Prof. Aurel Nanu's initiative, at which all colleagues from Romania immediately joined to. The conferences had in turn the names as CTN, CITN (Romanian abbreviations), ICNcT (in English) – see table 1.

The sections of conferences in the field of nonconventional technologies were multiple and their number was continuously growing over the time. The most accustomed were:

1. Electrical discharge machining;
2. Electrochemical machining;
3. Complex electrical machining;
4. Plasma and electromagnetic radiation machining;
5. Ultrasonic machining;
6. Water jet machining, control with magnetic fluids etc.

In all this period, the colleagues from the field presented in conferences over 1600 papers, which were published in bulletins of conferences or more recently, in the review of ARTN, *Nonconventional Technologies Review*, many handbooks, treatises, monographs, dissertations in Nonconventional Technologies specialization. Unaccountable participation at international conferences from abroad must be mentioned (France, Germany, Switzerland, Poland, Italy, Netherlands, Belgium Estonia, Russia, Ukraine, Hungary, Greece etc.).

The importance of the field can also be proved by so many and valuable researches in the frame of doctoral thesis, presently having PhD title in this particular over 150 specialists from higher education and research institutes. This outstanding activity in the field was substantiated by many patents in Romania, and abroad. In this context, many national and international awards were received by Romanian researchers in the field.

Laborious activity concerning nonconventional technologies allowed that in years 90's, emergence of such specializations in faculties from Braşov, Bucharest, Timişoara, Iasi and Sibiu, attended by numerous students with very good results.

All these mentioned above lead to the idea that our specialists understood the necessity of that moment, but also its importance for the future, acting in consequence. It also has to be mentioned good collaboration with

the research institutes from the field, ICTCM, ICPE, and with machines building enterprises. Most of all, it was of utmost importance the relations of collaborations with specialists from higher education and research from abroad. Such ways of action were materialized through mutual visits, changes of scientific materials, participation at symposiums and conferences organized by respective institutions.

Table 1. Conferences in the field of nonconventional technologies

No.	Year	Conference / Symposium	Location / Organizer
1	1971	Ist National Conference of Nonconventional Technologies	Timișoara
2	1977	IInd National Conference of Nonconventional Technologies	București
3	1982	IIIrd National Conference of Nonconventional Technologies	Sibiu
4	1983	IVth National Conference of Nonconventional Technologies	Timișoara
5	1986	"Nonconventional Technologies – way to increase technical-economical efficiency in machines building"	"Traian Vuia" Inst. Timișoara, Atomic Physics Inst. Bucharest
6	1989	Vth National Conference of Nonconventional Technologies	Timișoara
7	1989	Conference "Achievements in machines construction and exploitation"	Polytechnic Inst. Brașov
8	1991	VIth National Conference "Achievements and perspectives in the field of lasers and their applications in science and technology"	"Traian Vuia" Inst. Timișoara, Science Academy
9	1993	VIIth National Conference of Nonconventional Technologies	Timișoara
10	1997	VIIIth National Conference of Nonconventional Technologies	Timișoara
11	2000	IXth National Conference of Nonconventional Technologies	Brașov Univ.
12	2001	Xth National Conference of Nonconventional Technologies	"Politehnica", Bucharest
13	2003	XIth ICNcT – International Conference of Nonconventional Technologies	Sibiu
14	2004	"Concentrated energies - support of materials thermal machining", round table	Romanian Academy, Timișoara
15	2005	XIIth ICNcT – International Conference of Nonconventional Technologies	Bucharest
16	2007	XIIIth ICNcT – International Conference of Nonconventional Technologies	Iași
17	2009	XIVth ICNcT – International Conference of Nonconventional Technologies	Oradea
18	2011	XVth ICNcT – International Conference of Nonconventional Technologies	Arad
19	2013	XVIth ICNcT – International Conference of Nonconventional Technologies	Sibiu
20	2014	XVIIth ICNcT – International Conference of Nonconventional Technologies	"Politehnica", Bucharest

Note: The present summarizing table was elaborated based on information from the notes belonging to Prof. Dan Nanu (†) and colleagues from the country.

Let's conclude saying that the activity of our Romanian researchers was meritorious and it is needed, taking into account the field importance that it has to continue in the same mode.

In the end of this remember, let's give the pious recollection to all those who are not among us, and to the others, wishing them success in the future research activity!