



EXPERIENCE OF APPLICATION OF HF ELECTRIC WELDING APPARATUS EK-300M1 IN SURGERY

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Presented are the data illustrating advantages and areas of application of HF electric welding apparatus EK-300M1 in surgery.

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Development of equipment and technology for high-frequency electric welding (HFEW) of soft live tissues became a priority for Ukrainian scientists, engineers and doctors.

In 1991 Prof. B.E. Paton and Prof. V.K. Lebedev put forward a hypothesis and proposed mathematical model which were proved by series of experiments on animals. This allowed stating a possibility of electric welding of soft live tissues with preservation of their viability. It is time to develop the laboratory samples of techniques and experimental substantiation of the technology [1].

For this purpose an international project was developed in 1996 under the leadership of Prof. B.E. Paton with assistance of the E.O. Paton Electric Welding Institute (PWI), A.A. Shalimov National Institute of Surgery and Transplantology, International Association «Welding» and commercial credit company «Consortium Service Management Group Technologies Inc.», as well as series of medical institutions of Ukraine. Common work was successful. The first variants of system with dosed power supply, prototypes of samples of power sources and surgical instruments were proposed at the beginning.

Development of the power sources was stepwise. The first experimental variant was developed in 1992, the second in a period from 1995 to 1996, and the third one in 2003. EK-300M1 power source was developed in 2004 and its updated variant in 2007–2008 together with RI of Applied Electronics of NTUU «Kiev Polytechnic Institute» [2] and plant «Schytomash» (Lubny,

Poltava region). Experimental work was kept on during indicated periods in the PWI laboratories as well as in the clinics with assistance of the specialists of engineer and medical orientation.

The first State Certificate about registration of HFEW apparatus EK-300M1 in Ukraine was issued in January, 2001. This is a date of beginning of practical application for new method of tissue saving HFEW technology in surgery. The further State Registration Certificates were issued in 2004 and 2010. The State Certificates about registration in the Russian Federation (2006) and in Belarus (2009) were also obtained. Technology, method of HFEW and welding instruments were patented in Ukraine, Russia, USA, European Union, Canada, China, Japan and Australia [3–15]. All these allowed proceeding to the application of method of soft live tissue welding in different spheres at the clinics of 16 regions of Ukraine as well as in Russia, namely, three Moscow and Saint-Petersburg clinics.

Medical instruments being a constituent of the HFEW complex is developed simultaneously with work over the power source. Such main parameters as dimensions, form, weight of electrodes as well as requirement to design, i.e. comfortable operation, access to place of HFEW, workability of instrument in manufacture and repair are determined. All the types of electric welding medical instruments (forceps, clamps and laparoscopes) are the instruments of bipolar type. Instruments used for endoscopic and thoracoscopic surgical procedures are of a great interest. Experience of manufacture and practical application of such type of the instruments is accumulating. At that the experimental work is proceeded with and positive results are immediately transferred in the clinical conditions.



Large scope of experimental and research work promoted accumulation of experience of clinical application of HFEW and corresponding equipment.

The new electric welding technology is confidentially introduced in practice of surgery treatment of the patients with different pathologies. Continuous accumulation of experience in this direction allowed creating atlas «Tissue saving HFEW technology in surgery» in 2009. All the participants of development of this technology, i.e. specialists of engineer and medical orientation, became the authors of this book.

The atlas reflects the whole way from the first steps of researches up to the practical progress of clinicians who mastered around 130 types of surgical techniques as for 2009.

Development of given technology, improvement of HFEW equipment and new surgical techniques, increase of number of users of this equipment is observed today. Data on clinical application given by users of EK-300M1 equipment to new (after 2009) surgical techniques can be an example of this technology development. These are Odessa Regional Oncology Dispensary, Kiev Center of Endocrine Surgery, Institute of Pediatrics, Obstetrics and Gynecology of the NAMS of Ukraine, Donetsk Regional Anti-Cancer Center, V.P. Filatov Institute of Eye Diseases and Tissue Therapy, Zhitomir Regional Children's Hospital. These organizations successfully apply new techniques of surgery treatment using EK-300M1 for:

- septoplasty in children, in particular, in nooks;
- laryngeal cancer;
- treatment of pathologies of thyroid gland;
- organ saving operations on removal of tumor on ovaris in woman;
- bladder cancer;
- stomach cancer and breast cancer;
- metastatic lesions of liver (hepatic resection, marginal biopsy of liver, left and right hemihepatectomia, trisegmentectomia and bisegmentectomia);
- regmatogenous retinal detachment for blocking of retina rupture;
- endoresection of intraocular neoplasms;
- microsurgery of trabecular apparatus of eye and iris.

Original instruments for work in cavity of vitreous body of eye and technique for obtaining adequate devitalization of tumorous focuses that reduces a risk of uncontrolled bleeding in endoresection of uveal melanoma are developed up to

present time. HFEW technology is used at endoscopic, mainly laparoscopic operations in pediatric surgery for treatment of different pathologies.

Application of EK-300M1 apparatus in opinion of medical staff allows achieving:

- significant reduction of blood loss at operative surgical intervention;
- minimization of thermal and mechanical injury of tissue that result in preservation of living cells and faster regeneration of tissues in place of coagulation at retention of functional activity of organ, including the possibility of preservation of reproductive function;
- change of scheme of performance of operative intervention with achieving of more simplified access to injured organ (experience of neurosurgical and urological operations);
- possibilities of performance of tissue saving operative interventions;
- reduction of time of operative interventions, i.e. time of patient being under effect of narcotic drugs;
- reduction of period of postoperative rehabilitation;
- decrease of time of patient hospital stay;
- elimination of application of foreign suture material;
- reduction of number of necessary medical instruments;
- improvement of work conditions for surgery team, lighten the work of surgeon, in particular, at nooks;
- elimination of infiltration formation;
- reduction of postoperative pain.

Thus, we already have excellent instrument for fight against illnesses and method of alleviating human's physical suffering.

The present technology develops as a living organism. Control of power complex is improved and new design solutions for apparatus and instruments are developed. These efforts are directed at quality improvement and increase of scope of surgical operations performed. The new electric welding complex has been already tested under clinical conditions. It will be added to surgeons' arsenal in the nearest time, i.e. the possibilities of fight against the illnesses and render the qualified help to the patients are expanded. It should be noted that principle of operation of EK-300M1 power sources in improvement remain the same in accordance with acquired patents.

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NEWS

REGULATOR FOR RESISTANCE WELDING

Regulator for resistance welding RKSM designed for control of welding cycle in multispot AC resistance welding machines was developed by «Obert» Ltd (Kiev) being specialized on development and manufacture of electric automated mechanisms for welding machines.

Capability of setting of up to 99 welding modes with their cyclic change in a process of operation of welding machine is the peculiarity of the regulator.

Immediately 8 valves and up to 32 valves using external expander of the outlets can be controlled by the welding cycle regulator.

Main technical parameters of regulator

Power consumed, V·A	not more than 30
Dimensions, m	0.16 × 0.16 × 0.29
Weight, kg	not more than 4
Number of welding current pulses	1–99
Regulation of welding cycle time periods (compression–welding–pause between the pulses of welding–cooling–forging), s	0–399
Regulation of real values of welding current, %	0–99
Duration of welding current rise (modulation) is programmed in the ranges, %	0–99



Regulation of load power factor	0.2–0.8
Parameters of hyristor activation pulses:	
voltage, V	24
duration of pulse, μs	200 ± 150
Parameters of signal for power supply of output	
DC devices:	
voltage, V	24 ± 2
current, A	not more than 0.4
Number of actuating devices, pcs	up to 8
Number of outputs (including pedal)	4