Moscow Institute of Electronic Technology (Technical University)

The basic stages of defibrillation development in Russia

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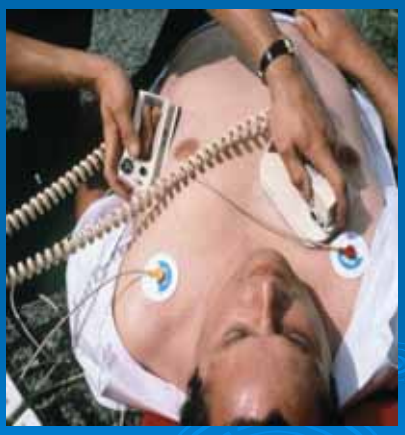
Moscow, 2009

Introduction

- Every year from a sudden heart arrest die:
- Europe ~ 700 000
- USA ~ 250 000
- Canada ~ 50 000



Yuniev G.S., Herchikova K.A., Nicolskaya M.I.

About influence of a strong electrical current of low frequency on heart.

Byulletin Eksper Biol & Med. 1937

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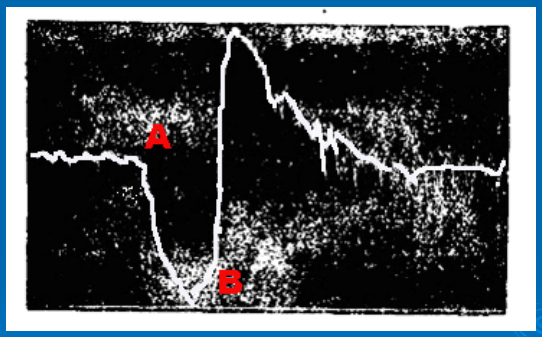
Restoration of heart rhythm during fibrillation by a condenser discharge, 1939

N.L. Gurvich (1905-1981)



Dog's blood pressure at the beginning and stopping of ventricular fibrillation

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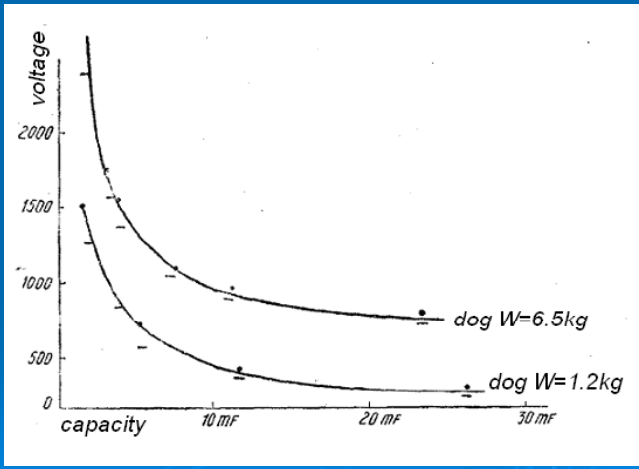
Dependence of voltage thresholds and discharge capacity under defibrillation, 1943



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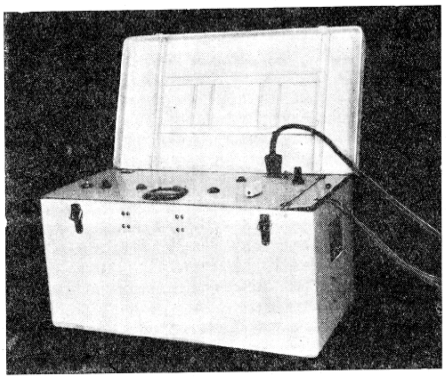
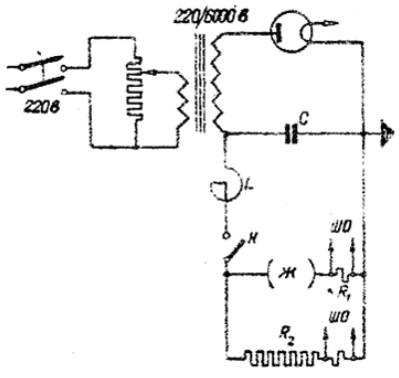
First Russian defibrillator, 1952



Defibrillator ID-1-VEI



Approximate circuit of defibrillator

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The comparative data of impulse currents sizes stopping fibrillation and causing infringement of heart normal activity at the dogs (capacity - 24 mkF)

№ dog	Weight	Inductance, H	Duration of a current, ms	Amplitude of a defibrillation current, A	Test at normally working heart	
					Amplitude of a current, A	Infringement of heart activity
1	8	0.28	10	6.4	8.5	No
					9.5	Yes
		–	2 – 3	15.2	12.2	No
					15.9	Yes
2	10	0.28	10	5.8	10	No
					12.4	Yes
		–	2 – 3	32.3	11.1	No
					14.8	Yes
3	14	0.28	10	11.2	8.2	No
					9	Yes
		–	2 – 3	32.8	12.7	No
					15.3	Yes

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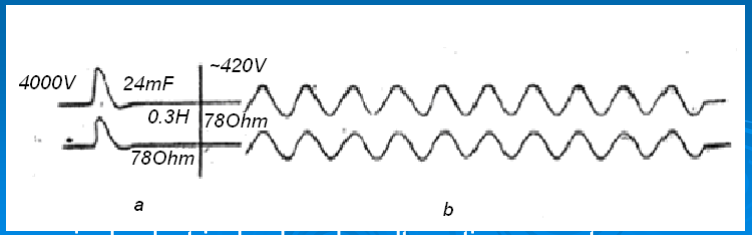
Comparative efficiency of a single electrical pulse and alternating current for heart defibrillation, 1966

The following features of defibrillation by an alternating current were marked:

- Absence of defibrillation strict threshold
- It was not possible to stop defibrillation at 4 of 9 dogs, weight more than 10 kg, even used maximal voltage 420B
- The efficiency of defibrillation does not depend on influence time by an alternating current, rational meaning is not exceeding 1 period (20 ms)
- Large duration does not facilitate defibrillation, however can call infringements in heart functioning



a – single electrical pulse b – alternating current

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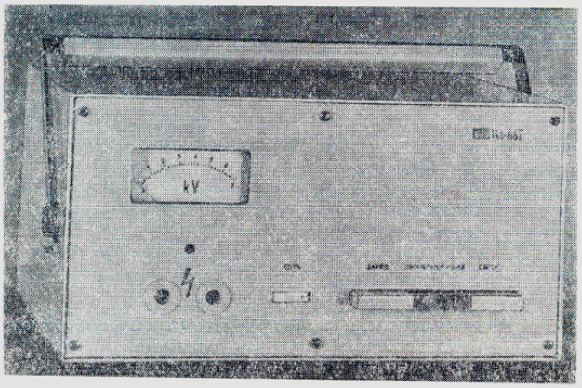
Second Russian defibrillator, 1966



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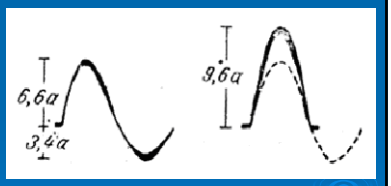
Heart defibrillation by biphasic electrical pulse, 1967

Comparative sizes of defibrillation current at a single-phase and biphasic impulse

Weight of dog (kg)	Capacity (mkF)	Threshold (A)		
		single-phase		biphasic
		No defibrillation	defibrillation	defibrillation
14.5	2	9.3	9.8	7.4+3.3=10.7
	4	8.9	10.4	7.4.+3.0=10.4
	8	8.1	9.6	6.3+2.6=8.9
	16	7.0	7.8	6.7+1.1=7.8
10	2	11.2	-	7.8+4.4=12.2
	4	9.5	11.4	7.6+3.6=11.2
	8	8.2	9.0	6.3+2.9=9.2
	16	7.6	8.3	7.0+1.5=8.5
8	4	8.9	9.6	7.9+3.5=11.4
	8	8.6	9.6	6.6+3.4=10.0
	16	7.2	7.9	6.7+1.3=8.0
19	8	13.2	14.2	10.2+1.6=11.8
	16	13.9	13.2	12.2+2.0=14.2



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Choice form of the biphasic pulse, 1971

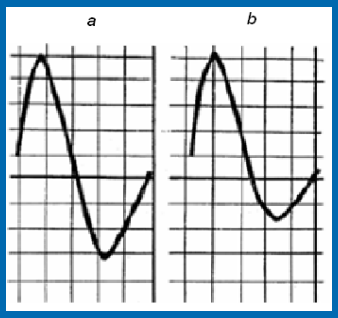
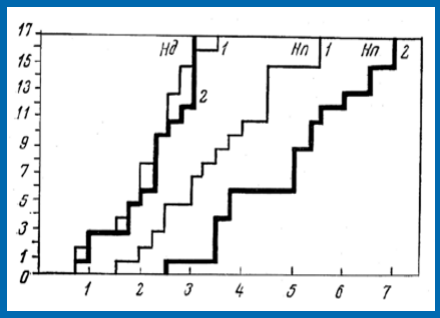


Diagram of biphasic pulses current
axis x - time (1 crate - 2мс).
axis y - current (1 crate 5 A).
a - ratio of current amplitudes 1:0.6
b - ratio of current amplitudes 1:0.3



Diagrams of defibrillation and damaging voltage
axis x - voltage in kV
axis y - number of animals
1 - impulse b
2 - impulse a
Нд - defibrillation voltage
Нп - damaging voltage

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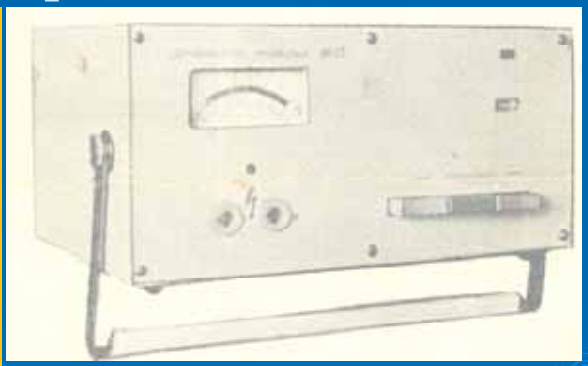
First defibrillators with biphasic impulse, 1971

DKI-01



DI-03

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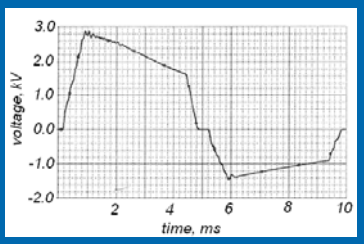
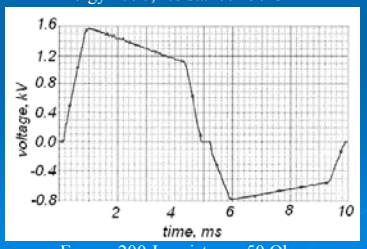
Defibrillator with an impulse form does not depend on resistance changes of a patient, 2002



Energy 200 J, resistance 150 Ohm



Energy 200 J, resistance 50 Ohm

Defibrillator DFR – 2 and president D. Medvedev

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Conclusion

For more than 50 years of the Russian history, defibrillator has turned from the dimensional impulse generator into the high intelligent microelectronic system, which allows not only supply urgent therapy, but also improve life quality of the patients.

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Thank you!

http://www.bms.miet.ru/

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