

PHYSICAL EFFECTS OF SCENAR-THERAPY

Since the direction called SCENAR-therapy and SCENAR-expertise has appeared, researchers and practitioners are searching for the answer to the question: why is the therapy effective and what is the distinction in kind of SCENAR devices as compared to other electrostimulators?

Some physical effects that accompany SCENAR-therapy and significantly provide its effectiveness are considered below.

Signal dynamic behavior.

The signal dynamic behavior is one of the distinctive features of the devices.

Investigations show that signal variability is determined by two processes: forming of double-layer capacity and effect from current pulses action.

We should note that the formation of double-layer capacity is first of all the effect of metal (device's electrode)-skin interaction (interaction on the border of first (electron) and second (ion) class conductors).

The metal is in contact with a complex system of water solutions that include a number of both inorganic and organic electrolytes. Potential drop (double electric layer) that occurs on the metal-solution border is called the electrode potential. Its equivalent circuit is a capacitor (double layer capacity) and resistance connected in parallel.

The double layer is formed due to the movement of metal ions to the electrolytic solution and reverse motion of mobile ions from the liquid around the electrode to its surface. The formation lasts for about 0.5-1 sec.

Then, the electrochemical reactions associated with the local metabolism develop between the electrode and solution. This provides the subsequent dynamics (change) of the electrode potential, and thus, that of the double layer capacity.

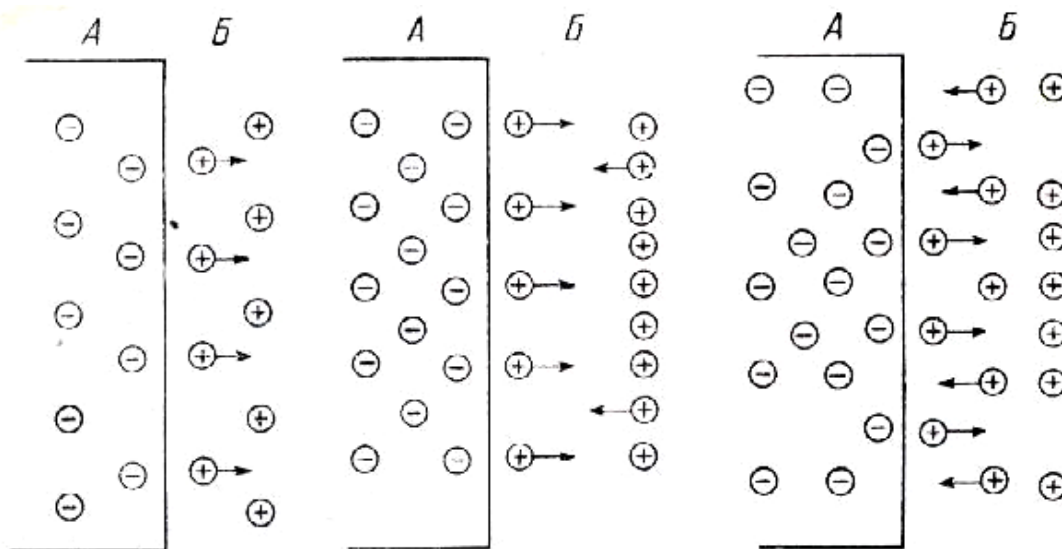
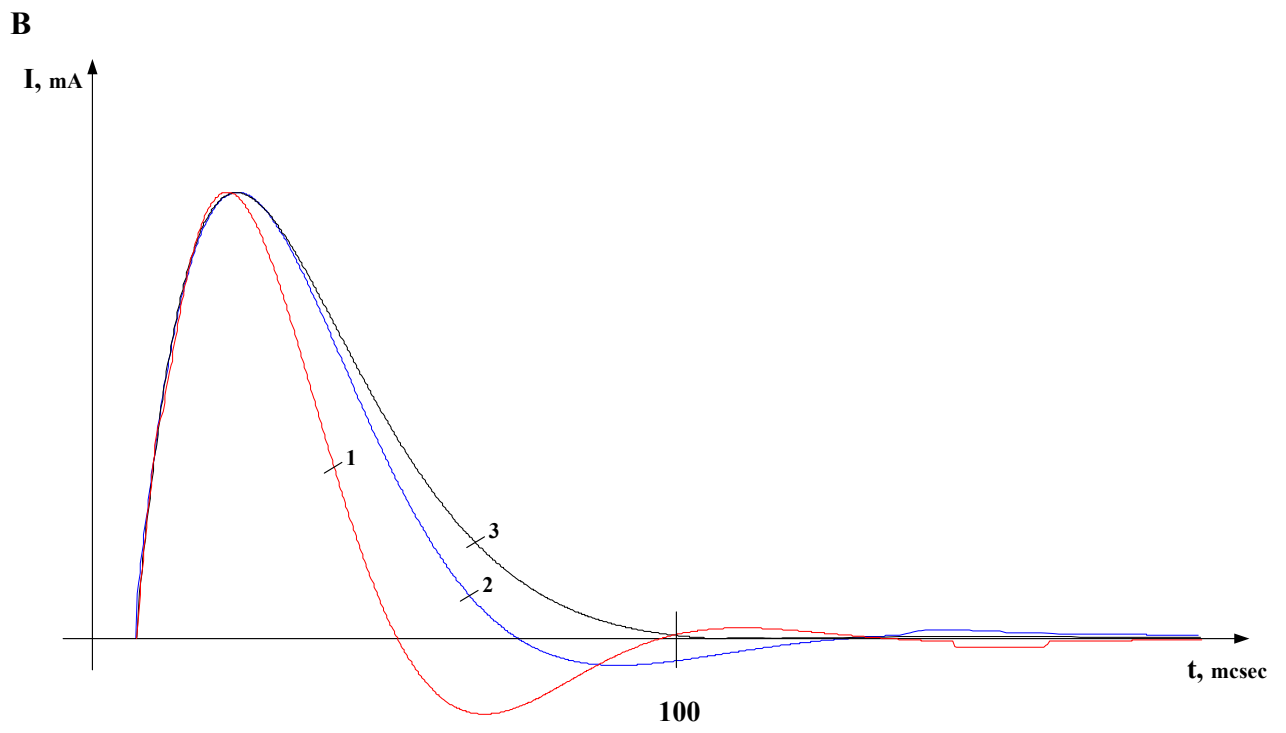
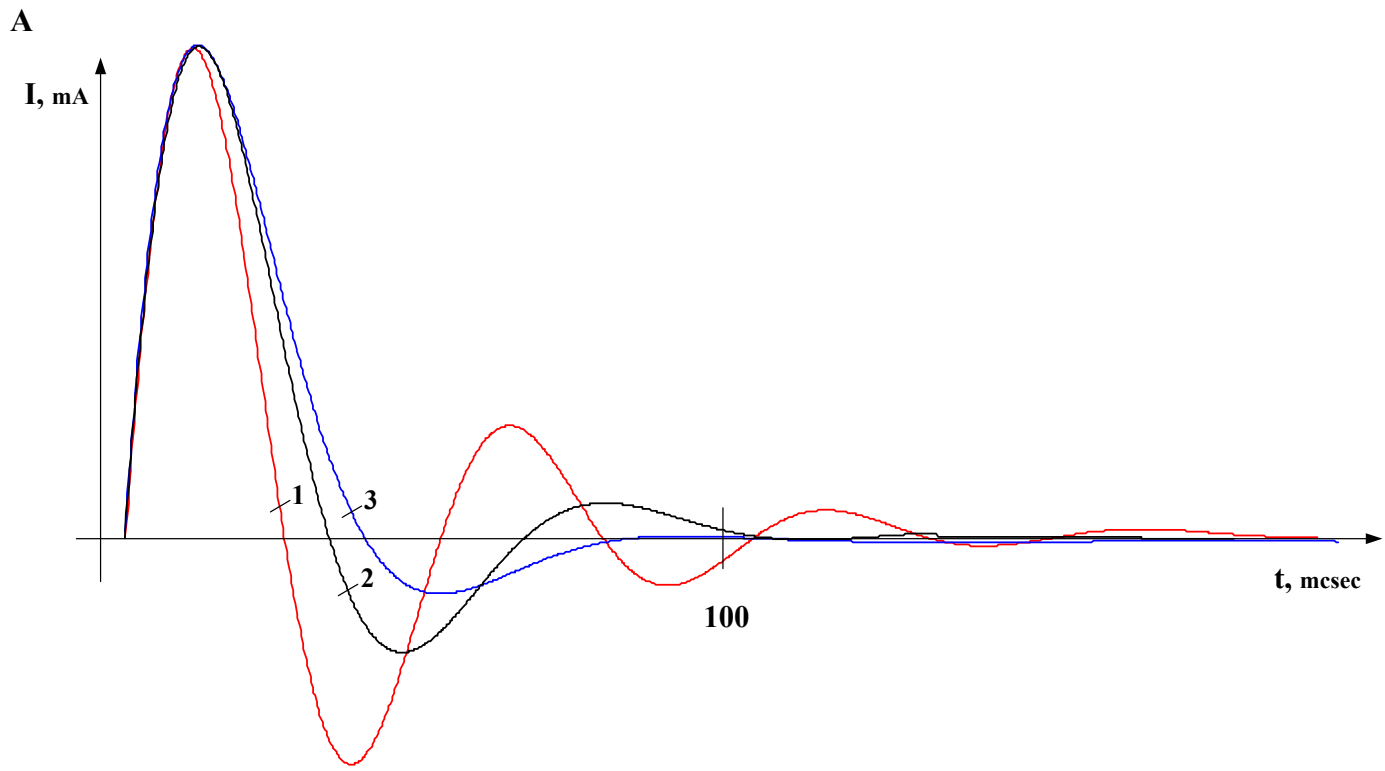


Fig.1 Stages of double electric layer formation on the electrode



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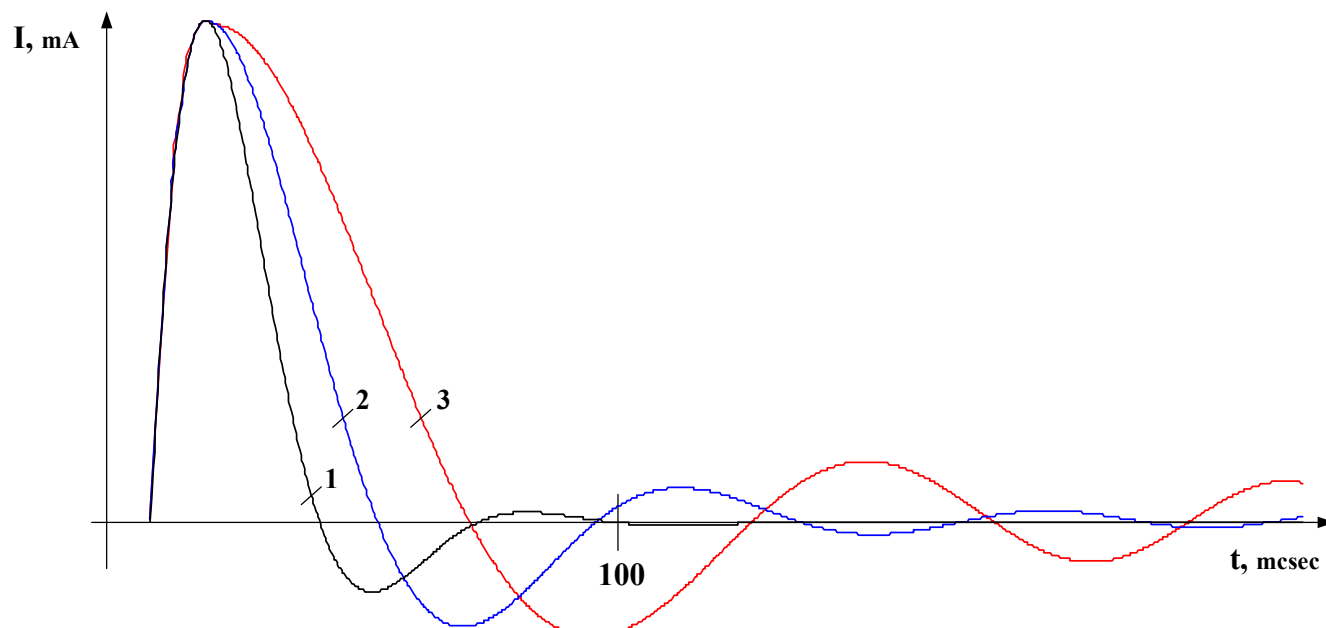


Fig.2 (A, B, C). Variants of electric current profiles at SCENAR-stimulation. 1 – signal 0.22 sec later (13th pulse); 2 – signal 1 sec later (60th pulse); 3 – signal 10 sec later (600th pulse).

When turning on the device, the effects from the current pulses action are imposed on the picture described above. When the skin is dry, the electric current action most often shortens the oscillation (Fig.2A, B). When the skin is wet, it most often increases the oscillation number (Fig.2C). The variants of electric current profiles at SCENAR-stimulation (when the device's electrode is on the skin) are given in the Fig.2 (A, B, C). The A, B, C profiles relate to different anatomic zones. In Fig.2 the first signal relates to the 13th pulse (0.22 sec later), the second signal relates to the 60th pulse (1 sec later); the third signal – to the 600th pulse (10 sec later). The pulse frequency is 60 Hz.

Feeling the increasing stimulation strength during the procedure.

It is well-known that during electrical treatment the signal strength is often increased (as the patient doesn't feel the stimulation). In case of SCENAR-therapy we have to decrease it (as the patient feels pain). Increasing the stimulation strength during the procedure is very much determined by technical reasons. SCENAR is a current generator, i.e. it is a source of energy (impulse source). The current amplitude in the output of the source is almost independent of the load (Fig. 2A, B, C). At the same time, the duration of all phases of the current and voltage impulse increases during the procedure. At the moment of touching, the voltage amplitude decreases very quickly. Then it usually decreases more slowly than the impulse extends. This results in increased stimulation energy (the energy is proportionate to the product of current and voltage and the time they are effective) and feeling of increased stimulation strength during the procedure.

Signal energy concentration. Simple studies show that the resistance of the subcutaneous tissue to the alternating current (and, certainly, to the direct current too) is much less for small-area electrodes than that on the electrode-skin border. The following experiment has been carried out. Two spaced electrodes, each of 1.5 sq. cm., were applied on:

1. Right hand: palm – back of the hand.
2. Left hand: palm – back of the hand.
3. Right hand – palm, left hand – back of the hand.
4. Left hand – palm, Right hand – back of the hand.

We should note that the space between the electrodes (current propagation path) in 1 and 2 is about 2-3 cm, and for 3 and 4 – about 1.5m.

The results showed that the current amplitude and signal shape are almost the same. So, most stimulation energy is concentrated on the electrode-skin border. The experiment proves the well-

known fact that skin resistance is provided by the thin superficial layer (corneal and lucid epidermal layers), and that approximately near the granular layer the resistance is zero.

Skin sound effect. One of the most specific effects accompanying SCENAR therapy is that there is a sound when moving the device on the skin.

And we certainly ask the question: where the sound originates from? Why does it appear? How and why does it stop?

The sound originates from the skin (and device's transformer coil often sounds too). This is a new phenomenon that has never been described earlier and that has never been observed in other electrostimulators and electrotherapy devices. Researches showed that skin sounds relate to high-amplitude stimulation. Electrotechnically, SCENAR is a current generator, i.e. it is a source of energy. The current amplitude at the output of the source is almost independent of the load (Fig. 2A, B, C). The amplitude of the first current half-wave is about 10-100mA, depending on the patient's individual sensibility. So, as the electrode area is small (the area of the central part is about 2 sq.cm), the current density at SCENAR-therapy is 5-50mA/cm² and exceeds this value 50-500 times, for instance, in case of sinusoidal modulated currents. The voltage amplitude at the moment of touching is very high for physiotherapy and makes up 200-500V. In the mode of therapy (comfortable stimulation), depending on the treated area and individual sensibility of patients, the voltage value is 20-200V.

So, high-amplitude stimulation provides the main feature of SCENAR-therapy – skin sounds. Let's consider two hypotheses that explain this effect.

One of the hypotheses is the disruption of the corneal epidermal layer (and maybe specifically – disruption of the corneal and lucid layers, although the lucid layer is not seen as a separate layer under an electronic microscope). The disruption induces oscillations, and, consequently – the sound. The arguments that prove this hypothesis: the sounding is maximal at the moment when the device is applied on the skin (after the disruption the voltage amplitude decreases, and the sound dies away), high sound volume when moving the device on the skin (voltage amplitude remains the same), in the broad band sound harmonics are the same as harmonics of stimulating pulses.

Epidermis disruption causes other paths of current propagation as compared to the low-voltage stimulation and induce the activation of greater number of nerve fibers (receptor endings, cells), and, therefore, to better therapy effectiveness.

Another hypothesis is the inverse tactile effect (neuromuscular transmission, receptor-skin transmission). It is well known that there are no strictly specialized (in terms of irritation perception) skin nerve receptors. They are only relatively specialized, so all receptors are touch-sensible, more or less. Direct stimulation of nerve fibers at high voltage amplitudes causes inverse effect – skin vibration, and consequently, skin sounds. The arguments for this hypothesis are the same as for the above one, including the broad band of sound frequencies. The latter seems to be logical if one takes into account that the ear membrane oscillates in the range up to 20000 Hz.

The third hypothesis is concerned with the direct influence of the high alternating electric field. The thickness of the corneal layer in adults is 13-15 microns on most of the body. The lucid layer thickness has the same order. So, the electric field intensity at the moment of impulse excitation exceeds 10⁶ V/m, which induces tissue attraction (repulsion), and the tissue goes back due to its own elasticity. The ion oscillation of the intercellular fluid is transmitted to the epidermis and causes vibration and sound.

Due to the high-amplitude stimulation, additional or much stronger (as compared to that of other electrostimulators) vibration develops. And a high-frequency massages of underlying tissues occur (high-frequency in terms of the pulse stimulation frequency and its harmonics). Irritation of the interstitial (intercellular) fluid, and maybe of cytoplasm (intracellular fluid) stimulates the transfer the fluid and its components (cellular metabolism products, neurotransmitters, neuromodulators, etc.). As a result, edemas resolve faster (proved by the therapy practice), congestions remove, tissue trophism and lymph drainage become much better, elasticity of single fibers and layers recover. Taking into account the crucial role of the interstitial structures in accumulation, supply and transport of the nutrient medium and metabolic products, the things mentioned above cause additional effects that provide general effectiveness of SCENAR-therapy.