

Suggestion, Calculations, Practical Approbation of the Resonant Amplifier of the Reactive Electrical Power

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Abstract – The aim of the paper consists in suggestion, theoretical and experimental justification of the principal workability of the electrical power amplifier proposed scheme consisting of two sequential resonant circuits with the regulated level of the electromagnetic coupling between them. Scientific novelty is determined by the formulated aim an achievement of which is based on conclusions of the theoretical analysis and experiments fulfilled for the acting model of the proposed electrical power amplifier. The base analytical expressions for the electromagnetic processes analysis in the scheme of the suggested resonant power amplifier are got. The reliability of the found analytical dependencies was shown with help of the limit passages to the according to analogs in the authoritative special publications. As the conducted experiments have shown that resonant conditions in the circuits of the suggested electrical power amplifier are fulfilling with high strictness (the frequency discrepancies are no more than ~ 0.8 %). The discrepancies between the measurement and the calculation results are quite small and can be explained by the external electromagnetic fields influence (the fields superposition of the "output" solenoid and the coupling transformer). In whole, the got results are illustrating the real possibilities of the power multiple amplifying (~35 times) in the suggested scheme of the electromagnetic resonant converter which was based on the advancement of the Tesla transformer creator ideas.

Keywords – active-reactive circuit, tesla transformer, q-factor, resonance, resonant power amplifier, reactive electrical power.

I. INTRODUCTION

The energy of any resonant physical systems (electrical, mechanical etc.) opening access to the external environment energy (or to a so-named ether) can be called the «resonant» energy. For example, the physical validity of the proposed term can be confirmed by the illustrative historical fact of the resonant mechanical energy manifestation. So, in Petersburg in 1905 the Egyptian Bridge through the Fontanka River was collapsed under passing of the cavalry troop. The step of the horses trained in the ceremonial march hit in resonance with the period of

the bridge natural oscillations. The latter one was unable to withstand the sharp increase of the mechanical stresses and was collapsed [1].

It should be noted that at resonance and outside it the force action from the side of the cavalry troop is the same since the total mass of horses and riders plus the force of impacts on the pavement remain unchanged. But under destroying the bridge, the fulfilled work was in no any way comparable with the immediate possibilities of its performers. It means that to the force action from the side of the cavalry troop the force conditioned by extracting the energy from surrounding space and which is the «resonant» energy was added.

In electrodynamics, an analogical phenomenon is accompanied by the appearance of the «resonant» electrical energy [2–4]. However, this term “resonant” does not exclude the possible and equitable use of other definitions of energy from the surrounding space, because the definitive scientific justification of origin of the energy this kind is absent in the modern scientific publications.

Not stopping on a nature of the resonant energy destroying the bridge it should be marked incredible possibilities of practical use of the given phenomenon in different areas of the modern science and technique. Trustworthiness of this conclusion confirms the physical principle of similitude allowing to tie the space and temporary characteristics of the different natural phenomena without their concrete causality [5].

II. BRIEF LITERATURE REVIEW. PROBLEM FORMULATION

Before passing directly to the review, should illuminate two main fundamental statements on which the present work is built. The first statement consists of the Tesla idea usage about the ether resonant energy in the surrounding space, which was embodied practically in the voltage super transformer called by his name. The second statement consists of the distinguished feature usage of the idealized scheme with two inductively coupled resonant circuits. This idealization assumes the zero active

resistance in the secondary circuit what allows to get voltage and current amplification what means the electrical power amplification eventually.

Let us start from the Tesla ideas.

Should mark that for the further comparison it is interesting to look through the book material [6] where the quite full information about the modern high voltage technique is represented.

So well, the most effective propose of the resonant energy usage with the transformation factor more than ~ 1000 times was patented else at beginning the last century and was titled by name of its inventor by "Tesla transformer" [7,8]. On principle, the latter consists of two inductively coupled resonant circuits. A particularity of this design is the multi-turn open-ended coil in the secondary circuit. Physically, the absence of the closed circuit with a load means that only displacement currents with quite small amplitudes can be excited between the coil output terminals.

In this connection, the Tesla transformer works as only voltage "super" amplifier but not a power amplifier. Numerous publications are known and dedicated to investigations of the Great Scientist [9-15]. So, enough full information about different inventions tied with Tesla transformer is represented in the publications [9,10]. These scientific editions contains many original non-edited draws of the Tesla works which relate to the alternating current, its sources, wireless transmission of the electrical energy, different designs of the electrical generators and many other very interesting and practically useful suggestions. Every his drawing has a detailed description of how the corresponding invention works. The optimal design and the real ways of effectiveness increasing of the Tesla transformer as a Scientific Instrument are described in a detail by the author of the works [11,12]. The possibilities to reach the optimum by modifying the main components are discussed here from a practical standpoint. At this reason, we'll stop on some interesting details. A methodology for maximizing the secondary voltage by regulating the tuning ratio and the coupling coefficient is examined in particular. It is shown that in the best case the secondary voltage increases of only $\sim 18\%$. But this decision is accompanied by severe engineering problems. From his side, the publication author recommends reaching the maximum voltage at the secondary winding in the shortest time (to minimize losses!), receiving the tuning ratio close to "1" and then increasing the coupling coefficient as much as possible, orienting at quantitative data which are given in the cited works. The investigations which are directed to increasing the effectiveness of the high voltage signals generating, to calculations and measuring the space-temporal distribution of the electrical field along the transformer secondary winding, to the appearance of the higher modes of oscillations in spectrum of the excited voltage etc. are described by authors of the works [14,15]. Finally, the engineering design solutions, the real projects, and the got results are represented in the articles [14-16]. It should be noted that all above-enumerated aspects of the problems tied with the transformer Tesla present in each of the cited works in the more or the less degree.

Principal new physical approaches for solving the problems of power engineering without known traditional sources are discussed by authors of the scientific publications [16-23]. The subjects of discussions are the so-called "Radiant's energy" of the Tesla transformer, "Free Energy", "Cold Electricity", "Energetic without Fuel", "Energy of Ether" etc. Many suggestions of the cited works authors will be possibly realized in the future. But from a standpoint of the real practical possibilities of our time should distinguish the very interesting information represented by an author of scientific monographs [25,16], where the very interesting discoveries of the American engineer and created by him the real acting devices are described. Edwin Grey showed that the high-voltage capacitor discharge can be transformed into the huge radiant energy burst. This energy was feeding all his demonstration installations, apparatuses, devices and charging his accumulators. Should mark that the Edwin Grey electromotor was consuming no more than $\sim 5\%$ the energy of the source. The publications [24-26] particularity consist in the proposal of an adequate physically-mathematical model for the theoretical analysis of the electromagnetic processes in the Tesla transformer. The trustworthiness of N. Tesla experimental conclusions is confirmed by the authors of the cited works. Here the numerical estimates of the output voltage amplitudes under variation of the working frequencies relatively the resonant value are received as well.

Before passing to the second fundamental statement about the distinguished feature usage of the idealized scheme with two inductively coupled resonant circuits the published works of the analogical directivity should be illuminated [27-28]. So, the patents [26,27] defend the inventions of the resonant transformer and resonant amplifier, correspondingly. But as the strict analysis of the patented devices showed that their practical realization is very difficult and even doubtful. The first attempt of the theoretical consideration of the possibility of the resonant amplifier creation is represented in the work [28]. With the help of the electrical circuit theory methods some analytical expressions for the main characteristics of the investigation subject were got.

Let Tesla transformer is complimented by the series inclusion of a concentrated capacitance in the circuit of the secondary winding. As it was mentioned before, on principle, this electric scheme consisting of two closed inductively connected circuits in the voltages resonance regime can be already amplifier not only of voltage but the current too if the active resistance in the secondary circuit equals to zero. A principle prove of this statement is given in the work [29].

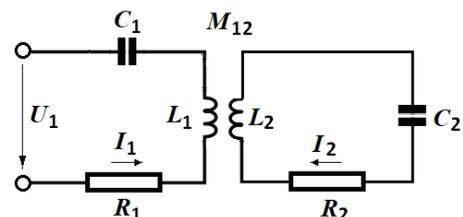


Fig. 1. The equivalent scheme of the two inductively coupled circuits, $R_{1,2}$ – are the active resistances, $L_{1,2}$ – are the inductances, $C_{1,2}$ – are the capacitances, M_{12} – is the mutual inductance, $I_{1,2}$ – are the excited currents, U_1 – is the harmonic voltage source

In the idealization when the active resistance is absent in the secondary circuit the equations system relatively of the complex currents and voltages with the frequencies – has the well-known kind [29]:

$$\begin{cases} \left(i\omega \left(\omega L_1 - \frac{1}{\omega C_1} \right) + R_1 \right) \cdot I_1 + i\omega M_{12} \cdot I_2 = U_1; \\ i\omega M_{12} \cdot I_1 + i \left(\omega L_2 - \frac{1}{\omega C_2} \right) \cdot I_2 = 0. \end{cases} \quad (1)$$

In resonance – $\left(\omega L_2 - \frac{1}{\omega C_2} \right) = 0$ and the expressions for the excited currents following from the above-given system – (1) can be written in a view:

$$\begin{cases} I_1 = 0, \\ I_2 = -i \cdot \frac{U_1}{(\omega M_{12})} \neq 0. \end{cases} \quad (2)$$

The authors of the cited work the relationships from (2) are interpreting by the following way. When the resonant conditions are fulfilled, the excited currents are set so that the electromotive force of the mutual induction – $i\omega M_{12} \cdot I_2$ from the side of the secondary circuit to the primary circuit balanced the voltage source (the first equation in the system (1)). Physically, by its nature, this case is similar to the resonance of currents in the circuit without loss.

Summary: at zero current in the primary circuit, the current in the secondary circuit has a finite value, which means the possibility of obtaining sufficiently large transformation ratios, but already for the current, not the voltage.

The essential demerit of this idealization consists in what it cannot be realized in practice. The active resistance of the secondary circuit can not be equaled to zero in reality.

Nevertheless, the Tesla idea and the considered idealization can be laid in a base of the practical implementation of the reactive power resonant amplifier. It has to consist of two inductive coupled sequential resonant circuits but with the active resistances of a finite value. The level of the electromagnetic coupling between them has to be regulated to avoid the transfer of the resonant energy from the secondary circuit to the primary one. Accordingly to the Tesla recommendations, this coupling has to be enough weak. It means that excitation of the secondary circuit has to be realized by small "portions" of energy and prevents its returning into the primary circuit. "Output" of the generated energy can be implemented from the secondary circuit inductance or from its capacitance.

The aim of the present paper consists in suggestion, theoretical and experimental justification of the principal workability of the electrical power amplifier scheme consisting of two sequential resonant circuits with the

regulated level of the electromagnetic coupling between them. **Scientific novelty** is determined by the formulated aim an achievement of which is based on conclusions of the theoretical analysis and experiments fulfilled for the acting model of the proposed reactive electrical power amplifier.

III. THEORY, NUMERICAL ESTIMATES

At once should mark that identically to the works [24,25,28] all below received calculation relationships are based on the physically "transparent" provisions and strict mathematical approach with the usage of the circuit theory methods.

Because the practical interest is a work of the investigated object in the stationary regime with harmonic currents and voltages the complex amplitudes method was applied exclusively without any hypotheses about surrounding environment constitution and physical reasons of the resonant phenomena [28,30].

Problem formulation.

- The equivalent circuit of the suggested power amplifier from two sequential resonant circuits with a coupling transformer between them is represented on Figure 2. Inductances of the primary and secondary transformer windings are $L_{1T}, 2T$, accordingly.

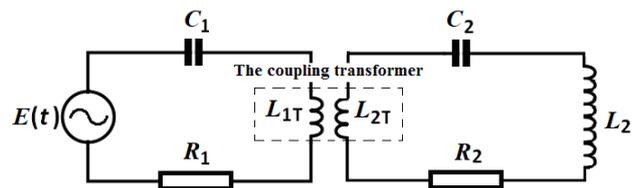


Fig. 2. The equivalent circuit of the suggested power amplifier

- The primary or "input" circuit contains the harmonic voltage source – $E(t) = E_m \sin(\omega \cdot t)$ (E_m – is amplitude, ω – frequency, t – time), the sequentially connected inductance – L_{1T} , capacitance – C_1 and active resistance – R_1 .
- The secondary or "output" circuit contains inductance – L_{2T} , inductance – L_2 which is an "output" element of the transformer in whole, capacitance – C_2 and active resistance – R_2 .

Remark. Because the voltages on reactive elements are the same the capacitance – C_2 can be "output" element as well.

- The frequencies of the primary and secondary circuits equal to each other so what $\omega_1 = \omega_2 = \omega$ – is the resonant frequency of the system.

The calculation of relationships.

The equations system describing processes in circuits of the suggested amplifier has a view [28,30]:

$$\begin{cases} E = I_1 \cdot \left(i \left(\omega L_{1T} - \frac{1}{\omega C_1} \right) + R_1 \right) + i \omega M_{12} \cdot I_2; \\ -i \omega M_{12} \cdot I_1 = \left(i \left[\omega \cdot (L_{2T} + L_2) - \frac{1}{\omega C_2} \right] + R_2 \right) \cdot I_2; \end{cases} \quad (3)$$

where $I_{1,2}$ – are the currents in circuits, $k \in [0,1]$ – is the coefficient of electromagnetic coupling,

$M_{1,2} = k \cdot \sqrt{L_{1T} \cdot L_{2T}}$ – is the mutual inductance of the coupling transformer windings between circuits.

Under fulfilling the resonant conditions $\left\{ \left(\omega \cdot (L_{2T} + L_2) - \frac{1}{\omega C_2} \right) = 0, \left(\omega L_{1T} - \frac{1}{\omega C_1} \right) = 0 \right\}$ the equations system (3) accepts a view:

$$\begin{cases} E = I_1 \cdot R_1 + i \omega M_{12} \cdot I_2; \\ -i \omega M_{12} \cdot I_1 = R_2 \cdot I_2. \end{cases} \quad (4)$$

The expression for the excited currents can be received from (4).

$$\begin{cases} I_1 = E \cdot \frac{R_2}{\left((\omega M_{12})^2 + R_1 \cdot R_2 \right)}; \\ I_2 = -i \cdot \frac{E}{Z}, \end{cases} \quad (5)$$

where $Z = \frac{(\omega M_{12})^2 + R_1 \cdot R_2}{\omega M_{12}}$.

It should mark that Z has a sense of a module of equivalent inductive resistance which ties the power source voltage with the resonant current in the second circuit. As it follows from the expression for I_2 the strict inductive connection has a place here.

A passage to the limit for $R_2 \rightarrow 0$ shows that $I_1=0$ and $I_2 = -i \cdot \frac{E}{(\omega M_{12})}$. It is fully agreed with the result for idealization in the work [31].

For confidence check of the got dependencies a relation of the voltage on the “output” inductance and the voltage on the first circuit inductance can be found. It is necessary for comparison with analogical relation in the Tesla transformer [26, 27].

According to definition and formula (5), we can find that

$$k \stackrel{def}{=} \left| \frac{U_{L_2} = (\omega L_2 \cdot I_2)}{U_{L_{1T}} = (\omega L_{1T} \cdot I_1)} \right| = k_{mp} \cdot Q_2, \quad (6)$$

where $U_{L_{1T,2}}$ – are the voltages on inductances $L_{1T,2}$ correspondingly, is the transformation coefficient conditioned by the electromagnetic induction phenomenon, $Q_2 = \frac{\omega L_2}{R_2}$ – is the Q – factor of the second circuit (without the inductance of the coupling transformer primary winding) determining a quantitative contribution of resonant effects in the voltage transformation process.

It should be noted that result (6) is fully agreed with the qualitative estimate of the similar parameter for the Tesla transformer in the article [24,25] (remind this is the prototype of the power amplifier). This parameter was determined by the invention author as a result of generalization of the numerous experimental data. He claimed that the efficiency of his transformer is being determined by the ratio of the inductive resistance of the second circuit to its active resistance.

Before passing to a quantitative interpretation of the got characteristics let us return to the second relation from (5) for the current in the second circuit – I_2 .

Obviously, the functional dependence $Z = Z(\omega M_{12})$ (has to have a minimum what will determine a maximum of the current – I_2 relatively of the argument – (ωM_{12}) . The known necessary condition of the extremum existence for $Z = Z(\omega M_{12})$ has the view [30]:

$$\frac{dZ(\omega M_{12})}{d(\omega M_{12})} = \frac{(\omega M_{12})^2 - R_1 \cdot R_2}{(\omega M_{12})^2} = 0. \quad (7)$$

As it follows from expression (7) the module of the equivalent resistance $Z = Z(\omega M_{12})$ as the function of the argument – (ωM_{12}) reaches the minimum if $(\omega M_{12})_{min} = \sqrt{R_1 \cdot R_2}$. And the resistance minimum will be equaled to $Z_{min} = 2\sqrt{R_1 \cdot R_2}$.

In terms of the resonant amplifier scheme the implementation condition of the minimum resistance – Z_{min} has the view:

$$\omega \cdot k_{12} \cdot \sqrt{L_{1T} \cdot L_{2T}} = \sqrt{R_1 \cdot R_2}. \quad (8)$$

The value of the electromagnetic coupling coefficient – k_{12} which ensures the secondary current maximum can be got from expression (8).

$$k_{12-\max} = \sqrt{\frac{R_1 \cdot R_2}{(\omega \cdot L_{1T}) \cdot (\omega \cdot L_{2T})}} \quad (9)$$

Physically, the found minimum of the equivalent resistance and the according to the maximum of the resonant amplifier effectiveness can be explained by a minimum possible "back return" of energy from the secondary circuit into the primary one what is provided by the level of the electromagnetic coupling in accordance with the formula (9).

It should be especially marked that the got expression for the coefficient of the electromagnetic tie level allows fulfilling the preliminary estimates what is necessary for practical realizing N. Tesla recommendations in accordance to which the resonant excitation of the "output" circuit has to be occurred by enough small electrical actions from the side of the "input" circuit with the working frequency equal to the own frequencies of the amplifier circuits.

$$\left\{ \begin{array}{l} I_{1m} = \frac{E}{2R_1}; \\ U_{L_{1T}m} = E \cdot \frac{Q_1}{2}; \\ P_m = \frac{E^2}{2R_1}; \\ I_{2m} = \frac{E}{2 \cdot \sqrt{R_2 \cdot R_1}}; \\ U_{L_{2T}m} = E \cdot \frac{(\omega \cdot L_2)}{2 \cdot \sqrt{R_2 \cdot R_1}}; \\ P_{2m} = \frac{E^2}{R_1} \cdot \frac{Q_2}{4}; \end{array} \right. \quad (10)$$

$Q_1 = \frac{(\omega \cdot L_{1T})}{R_1}$ – is the Q -factor of the input circuit.

$$\left| \frac{I_2}{I_1} \right| = \sqrt{\frac{R_1}{R_2}} \quad (11)$$

It follows from (11) the currents ratio is inversely proportional to the square root of the active resistances ratio in the circuits. It means the relationship between the excited currents is determined by the energy dissipation level.

The ratio of the output and input powers which determines the maximum of the energy conversion coefficient in the suggested resonant amplifier will equal to:

$$K_{\max} = \frac{P_2}{P_1} = \frac{Q_2}{2} \quad (12)$$

It should be marked that as it follows from (12) the amplifying coefficient maximum is reached at the account of the resonant excitation of the amplifier scheme. Some analysis results of dependencies (10)–(12), which describe electromagnetic processes in the regime of the efficiency maximum are represented below in the next positions.

- The got results are the quantitative characteristics of the reactive power resonant amplifier which consists of two inductive coupled serial RLC – circuits.
- Unlike to the Tesla transformer in the converter suggested scheme we have the transformation not only of the voltage but of the electrical power.
- Coupling between the resonant current and the voltage of the power source has the inductive character and the coupling equivalent resistance can be interpreted as the equivalent inductance of all system in whole.
- If the necessary parameters are chosen the resonant converter parameters suggested scheme can be considered as the electric power amplifier with the maximum possible amplifying coefficient – $K_{\max} = 0,5 \cdot (\omega \cdot L_2 / R_2)$, ω, L_2, R_2 – are the resonant frequency, output inductance, active resistance of the secondary circuit.
- Physically, the power amplifying maximum by the resonant amplifier is conditioned by the minimum possible "back return" of energy from the secondary circuit into the primary one with the input harmonic voltage source.

Let us pass to the concrete estimates.

The description of the subsequent material will be conducted in parallel comparison of the theoretical analysis conclusions, the numerical estimates and the experimental results for the acting model of the reactive power amplifier.

The element base of the amplifier according to its experimental model on Figure 3 (the principle equivalent scheme is on Figure 2).

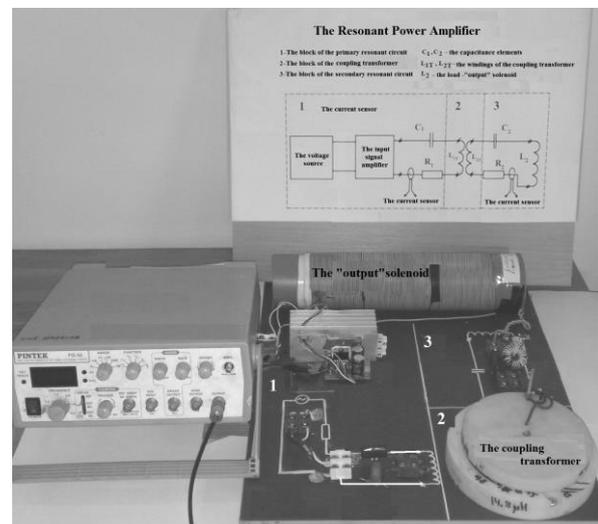


Fig. 3. The experimental model of the resonant amplifier of the reactive power

- The primary “input” circuit – 1: $E(t) = E \sin(\omega \cdot t)$ is the power source of the harmonic voltage with amplitude – $E = 1 \text{ V}$ and the working frequency – $\omega = 2\pi \cdot 25000 \text{ Hz}$, $R_1 = 0,1 \text{ Ohm}$ – is the active resistor, $C_1 = 2,763 \cdot 10^{-6} \text{ F}$ – is the capacitance, $L_{1T} = 14,8 \cdot 10^{-6} \text{ H}$ – is the inductance of the primary winding of the coupling transformer between the circuits.

- The coupling transformer block – 2.

- The secondary “output” circuit – 3: $L_{2T} = 14,8 \cdot 10^{-6} \text{ H}$ – is the inductance of the secondary winding of the coupling transformer between the circuits, $C_2 = 0,22 \cdot 10^{-6} \text{ F}$ – is the capacitance, $L_2 = 169,2 \cdot 10^{-6} \text{ H}$ – is the “output” inductance, $R_2 = 0,35 \text{ Ohm}$ – is the active resistor.

Calculations and measurements.

The “input” circuit

1. The working frequency: 25 kHz – is the calculation, 24,89 kHz – is the experiment.

2. The coefficient of the electromagnetic coupling between the windings of the coupling transformer: $k_{12\text{-max}} \sim 0,08$ – is the calculation, $k_{12\text{-max}} \sim 0,093$ – is the experiment.

3. The excited current: $I_{1m} = 5,0 \text{ A}$ – is the calculation, $I_{1m} = 5,46 \text{ A}$ – is the experiment.

4. The voltage on the coupling transformer primary winding: $U_{L_{1T}m} = 11,0 \text{ V}$ – is the calculation, $U_{L_{1T}m} = 11,58 \text{ V}$ – is the experiment.

5. The source power: $P_{1m} = 5,0 \text{ VA}$ – is the calculation, $P_{1m} = 5,46 \text{ VA}$ – is the experiment.

The “output” circuit

6. The working frequency: 25 kHz – is the calculation, 24,93 kHz – is the experiment.

7. The excited current: $I_{1m} = 2,7 \text{ A}$ – is the calculation, $I_{1m} = 3,39 \text{ A}$ – is the experiment.

8. The voltage on the coupling transformer secondary winding: $U_{L_{2T}m} = 6,19 \text{ V}$ – is the calculation, $U_{L_{2T}m} = 5,8 \text{ V}$ – is the experiment.

9. The “output” power in inductance – L_2 : $P_{2m} = 189,2 \text{ VA}$ – is the calculation, $P_{2m} = 191,2 \text{ VA}$ – is the experiment.

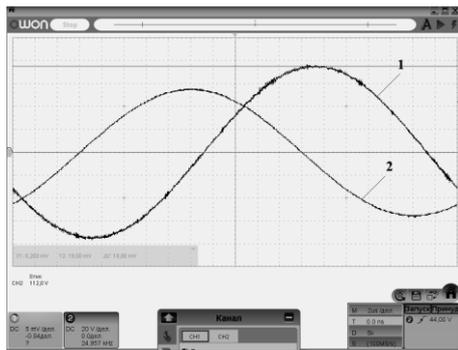


Fig. 4. The typical oscillogram: current in the “output” inductance – 1, the voltage – 2

The integral indicators

1. The ratio of the “output” power of the converter and the “output” power of the primary circuit:

$$\frac{U_{L_{2m}} \cdot J_{2m}}{U_{L_{1Tm}} \cdot J_{1m}} = \left\{ \begin{array}{l} 3,2 - \text{is experiment} \\ 3,3 - \text{is calculation} \end{array} \right\} \Rightarrow$$

discrepancy is $\sim 3 \%$.

2. The ratio of the “output” power of the converter and the source “output” power – is the electrical power amplifying coefficient:

$$K = \frac{U_{L_{2m}} \cdot J_{2m}}{E \cdot J_{1m}} = \left\{ \begin{array}{l} 35,0 - \text{is experiment} \\ 37,8 - \text{is calculation} \end{array} \right\} \Rightarrow$$

discrepancy is $\sim 9 \%$.

IV. CONCLUSIONS

1. The principal workability of the suggested scheme of the reactive power amplifier consisting of two sequential resonant circuits with the regulated level of the electromagnetic coupling between them was theoretically and experimentally justified.

2. The base analytical expressions for the electromagnetic processes analysis in the scheme of the suggested resonant power amplifier consisting of two serial inductive coupled circuits are got.

3. The reliability of the found analytical dependencies was proved with help of the limit passages to the according to analogs in the authoritative special publications.

4. It was shown that the maximum possible amplifier coefficient of the electrical reactive power is equaled to – $K_{\text{max}} = \frac{Q_2}{2}$, where $Q_2 = \frac{\omega \cdot L_2}{R_2}$ – is the Q -

factor, ω , L_2 , R_2 – are the resonant frequency, the “output” inductance, the active resistance of the “output” circuit of the proposed resonant amplifier.

5. The conducted experiments have shown that resonant conditions in the circuits of the suggested electrical power amplifier are fulfilling with high strictness (the frequency discrepancies are no more than $\sim 0,8\%$).

6. The discrepancies between the measurement and the calculation results are quite small and can be explained by the external electromagnetic fields influence (the fields superposition of the “output” solenoid and the coupling transformer).

7. The theoretical and experimental investigations agree with N. Tesla recommendations in accordance to which the resonant excitation of the “output” circuit has to be occurred by the small electrical actions from the side of the “input” circuit with the working frequency equal to the own frequencies of the amplifier circuits.

In whole, the got results are illustrating the real possibilities of the power multiple amplifying (~ 35 times) in the suggested scheme of the electromagnetic resonant

converter which was based on the advancement of the Tesla transformer creator ideas.

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Пропозиція, розрахунки, практична апробація резонансного підсилювача реактивної електричної потужності

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Метою статті є пропозиція, теоретичне та експериментальне обґрунтування принципової дієвості запропонованої схеми підсилювача електричної потужності, що складається з двох послідовних резонансних контурів з регульованим

рівнем електромагнітного зв'язку між ними. Наукова новизна визначається встановленою метою, досягнення якої засноване на выводах теоретичного аналізу та експериментів, перевірених на діючій моделі запропонованого підсилювача електричної потужності.

Показані два основних фундаментальних твердження, на яких побудована дана робота: перше твердження складається з використання ідеї Тесли про резонансну енергію в навколишньому просторі, яка була втілена практично в супертрансформаторі напруги, названому його іменем. Друге твердження складається з використання відмінних рис ідеалізованої схеми з двома індуктивно зв'язаними резонансними контурами. Ця ідеалізація передбачає нульовий активний опір у вторинному контурі, що дозволяє отримати посилення напруги та струму, і це, як наслідок, означає підсилення електричної реактивної потужності з часом. Отримані базові аналітичні вирази для аналізу електромагнітних процесів у схемах запропонованого резонансного підсилювача потужності. Достовірність знайдених аналітичних залежностей була показана за допомогою попередніх переходів до аналогів в авторитетних спеціальних публікаціях. Як показали проведені експерименти, резонансні умови в схемах запропонованого підсилювача електричної потужності співпадають з великою точністю (відхилення за частотою не більше $\sim 0,8\%$). Розбіжності між результатами вимірювань та розрахунками є досить малими та можуть бути пояснені впливом зовнішніх електромагнітних полів (суперпозиція полів «вихідного» соленоїду та трансформатора зв'язку). У цілому отримані результати ілюструють реальні можливості багатократного посилення реактивної потужності (~ 35 разів) у запропонованій схемі електромагнітного резонансного перетворювача, що заснований на розробці ідеї створення трансформатора Тесла і узгоджуються з його рекомендаціями що до резонансного збудження "вихідної" схеми.

Ключові слова – активно-реактивний контур, трансформатор Тесла, добротність, резонанс, резонансний посилювач потужності, реактивна електрична потужність.