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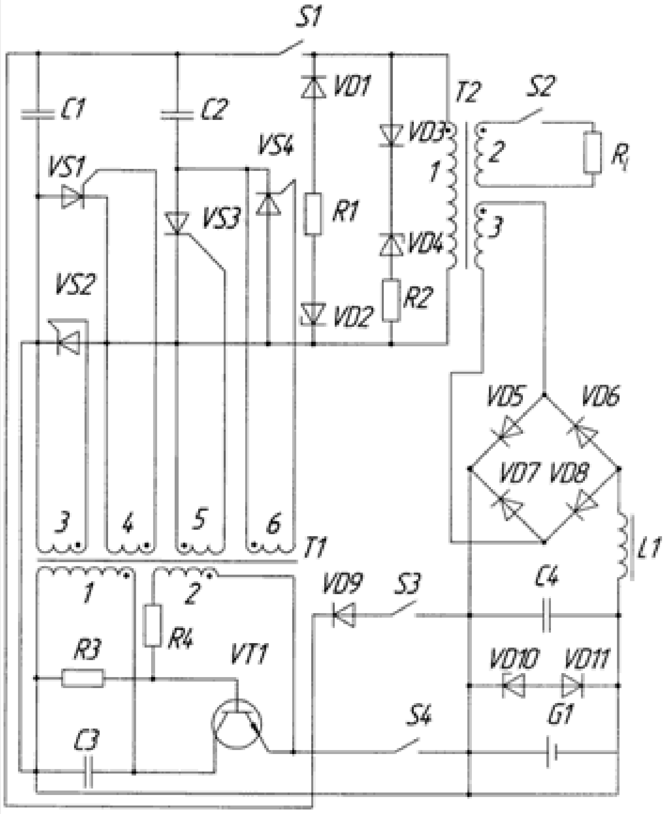
(54) the **SWITCHING MODE EXCITATION of PARAMETRIC RESONANCE ELECTRIC FLUCTUATIONS and device for its IMPLEMENTATION**

(57) Summary:

The invention relates to the field of electricity, more specifically, to an autonomous power sources, and can be used in industry, household appliances and transport. The Technical result is the simplification and cost reduction. In the switching mode excitation of parametric resonance and device for its realization due to the excitation of the commutation method of parametric resonance electric fluctuations generated reactive power capacity. This phenomenon is reactive electric power generators (GRAHAM). The kolebatel'nomu path at specific points in time in specified mode by using thyristors connected in parallel an additional inductor or capacitor with a nominal value of inductance or capacitance relative to similar elements in the primary circuit. This allows you to modify the parameters of the fluctuations during every path (inductance, capacitance, frequency, impedance) in accordance with the algorithm change control voltage, the thyristor to be placed from a single pulse generator (IG), and thus non-parametric resonance of a functional link voltage and current amplitudes in and with a control voltage. Parametric oscillation amplitude fixed by Zener diodes, resistors, terminated with parallel paths, which, passing through some of the involved in the fluctuation of charge and dissipating excess reactive power, limit the amplitude of the voltage and current required to outline health limits. The GAME is financed by a portion of the output of the GRAHAM, that

provide full autonomy of GRAHAM as a power source. 2 NP f-Ly, 7 IL.



Фиг. 1

The invention relates to the electric power industry, more specifically, to an autonomous power sources, and can be widely used in the industry, household appliances and especially in transport.

All currently known sources of power supply for their physical nature are transducers of different types of energy (mechanical, chemical, electromagnetic, nuclear, thermal, light) into electricity and implement only those costly ways to produce electric energy.

The objective of the present invention is based on parametric resonance electric fluctuations autonomous power source (generator), not sophisticated in design and not expensive on the cost of manufacturing in accordance with the technical level. Under autonomy, the present invention means the full operational independence of the source from the effects of any third-party or other forms of energy. In this description, parametric resonance () refers to the phenomenon of continuous increase in the amplitude of electrical oscillations in the oscillatory circuit with periodic changes one of its parameters (inductance or capacitance). These fluctuations occur without participation of external electromotive force (EMF).

Classic energy theory of OTHERS is that when you change the capacity or inductance circuit at specific points in time through 2 plates of the capacitor or inductor coils stretching (IR), with the subsequent return these settings to its original position in the circuit is allocated additional energy that causes the buildup of the amplitudes of the voltage and current. The emergence of this extra energy due to the preliminary cost of mechanical energy to overcome the Coulomb attraction force amperovskih or plates or coils.

The closest to a technical solution to the described invention is inductive and capacitive parametric machines created in 1931-1932 (academicians L. I. Mandelshtam, N. D. Papaleksi. The original work on the parametric excitation of electrical oscillations ". Journal of technical physics. Volume IV, issue 1).

Change the path in these machines produced by rotating disks with the slits, inserted into the gap core IR or between the plates of the capacitor and planted on the motor shaft is connected to an outside power source. Disk slots in the magnetic or dielectric permittivity was the air gap in the core or between the plates of the capacitor values of these quantities in disc used in the manufacture of the materials. So when rotating disk periodically changing dielectric constant dielectric capacitor or IC core permeability, leading to changes in total capacity or inductance circuit in General.

Made with parametric machine experiment has shown that under certain speeds of rotation of the shaft in the developed REGIONS, accompanied by continuous steady increase in voltage and current amplitudes. Increase the amplitude was not only decreasing inductance or capacitance circuit, but also with their increase, contrary to the classical energy theory ETC.

Despite the positive results achieved in scientific pursuits, this method of excitation ETC had a number of significant disadvantages for practical application. Nature of change wore sinusoidal nature and required certain overhead mechanical energy to overcome the Coulomb and amperovskih forces, impeding the rotation of the discs. These costs are in direct proportion to the peak values of voltage and current that developed in the path. Modulation depth (relative change) parameters was low (12-40%), the frequency of changes was the speed of the motor shaft, affecting stability and parametric excitation capabilities. Requires a separate power supply for the motor revolutions which had to carefully stabilize under changing loads on the shaft due to feedback from the load with amplitudnymi values of current and voltage in a circuit.

Technical level, existing at the time, did not allow to overcome these disadvantages, so the practical application of the parametric machine not found.

In addition, the authors of the machines were purely parametric research purposes without any further implementation of established laboratory facilities as sources of supply.

Switching mode excitation ETC electric fluctuations can be spasmodic nature changes inductance or capacitance of the oscillatory circuit, high depth of modulation parameters (300%) and conditionally constant energy to change settings that do not depend on the peak values of current and voltage in a circuit.

The method consists in that in certain moments of time to kolebatel'nomu path through the thyristors connected additional IR or condenser that leaps tend to skew overall inductance or capacitance of the main contour.

Thyristor, working with an electrode (trinistornyj), has two stable States. When applying a positive voltage $U_{\nu s}$ between the electrode and the cathode the thyristor is opened and remains open, regardless of whether the control voltage. The thyristor is closed only after the control voltage $U_{\nu s}$ if you subsequently change the direction the current is flowing through to the opposite or zero. The thyristor remains in the open position one-way conduction as a diode. With increasing anode voltage to a certain critical value U_a thyristor is opened, regardless of whether the control voltage. The thyristor voltage manager not opening depends on the size of the thyristor direct current flowing through and is defined only by its design and used in the manufacture of the materials.

The thyristor is a time of transition from one State to another amounts to approximately 10^{-5} with. 50 Hz frequency, used in most sources of alternating current (period fluctuations in^{-2} with 10), so switching the thyristors can be abrupt.

An additional capacitor or IC connected to the circuit in parallel. The ratio between the nominal values of inductances or capacitances of the basic and additional elements is one to three.

A smaller capacitance (c) is the main, large capacity (3 c)-optional. In this connection the equivalent capacity of existing capacity rather than a 1 c $ C_{eq}, which is equal to:

$$C_{eq} = 3C + 1C = 4C \qquad (1)$$

Conversely, a large inductance (3 l) is the main, lower inductance (L)-optional. In this connection the equivalent inductance of the circuit inductance L will be available instead of the L-$_{eq}$, which is equal to:

$$L_{eq} = (3L \cdot 1L)/(3L + 1L) = 0,75L \qquad (2)$$

After switching the setting circuit is increased or decreased in four times that changes the frequency of the oscillation circuit ω, which is determined by the following formula

$$\omega = (LC)^{-0,5} \qquad (3)$$

This enables the switching circuit oscillations in two frequency modes: the main resonance frequency ω and parametric frequency 2ω or 0.5ω. These frequencies are resonant for both modes, in which equality of wave, inductive and capacitive impedances. Thus is the first condition of parametric frequency-frequency in relation to the fundamental frequency contour.

Connection of an additional capacitor or IC are made at the moment of achieving the maximum current in the circuit and turn off-at zero current. The voltage in the circuit in these moments is zero or maximum value, respectively. By changing the parameters of the period of oscillation circuit operates on the fundamental frequency, and some on the parametric frequency. The resulting variation is the addition of the two above-mentioned fluctuations.

Physical meaning of switching mode excitation of PR is as follows. Magnetic and electric field are still static environment, disturbance (deformation) which are linked and describe the Maxwell equations. In electrical engineering degree of disturbance of the magnetic field is estimated to be potokosckepleniem (the total flow of magnetic induction) Ψ, and electric field-the voltage on the capacitor facings of u. in the circuit the quantities respectively opposed the current (speed) I and the charge q (electricity).

All these values and material conservation and obey the laws of matter and switching their existing values for the outline of the field and describes the following equations:

$$U = q / C \qquad (4)$$

$$\Psi = LI \qquad (5)$$

where Ψ is the flux linkage (total flow of magnetic induction);

L-inductance of the circuit;

I-current in the circuit;

U-voltage condenser; facings

q-charge (electricity);

With the capacity of the condenser.

The left part of the equations represent perturbations in the surrounding fields, the right parts-related disturbances in the path. To create disturbances require expenditure of energy field or a path which, if they eliminate these disturbances source back-field or the path. Energy disturbances are square equations:

$$W_e = CU^2 / 2 = q^2 / 2C \qquad (6)$$

$$W_m = \Psi^2 / 2L = LI^2 / 2 \qquad (7)$$

where W_e -Max electric energy;

W_m -maximum magnetic energy.

The duality of these equations is that the first part of the equation expresses the energy of the disturbance in the fields, and the second-the energy in the circuit. In fact in equations (5), (6) does not reflect energy and energy fields and change the path if you have or the disappearance of magnetic or electrical disturbances. These changes in energy fields and contour are equal but opposite in sign. If the energy circuit when charging a capacitor increases, the energy of the electric field is reduced by the same amount. At increasing current energy path is reduced, and the energy of the magnetic field is increased by the same amount. The algebraic sum of the changes in the energy field and the circuit is zero.

Moreover, the relationship between equations (4) and (5) is determined by the following dependencies of maximum values values are in opposite phase:

$$U = IZ_c \qquad (8)$$

$$\Psi = qZ_c \qquad (9)$$

where $Z_{(c)}$ -wave impedance.

Unlike capacitive and inductive resistances depending on frequency, the wave impedance is a universal characteristic of the path linking the major modifiable settings:

$$Z_c = (L / C)^{0,5} \qquad (10)$$

Equations (4) and (5) is also linked with the following maximum values, ratios are in opposite phase:

$$I = Kq\omega \qquad (11)$$

$$\psi = KU / \omega \qquad (12)$$

where ω is the frequency of the circuit;

K-dimensionless constant of proportionality.

Another measure between changing electric and magnetic field perturbation is the EMF of self-induction E_L, which reflects the movement of transient speed and is expressed by the following dependence:

$$E_L = d\Psi / dt = LdI / dt \qquad (13)$$

where $d\Psi/dt$-the rate of change of magnetic field;

dI/dt is the rate of change of current in the circuit.

Inductance, capacitance, frequency, impedance on the physical meaning of the proportionality coefficients are (correspondence) between the magnetic and electrical perturbations, as well as between contour and field perturbation forms of these and related changes in the energies.

The free vibrations of equation (4) to (12) are in balance. The first-quarter period, the fluctuations in electrical power circuits, lumped in the condenser, is reduced and the magnetic energy fields around the IR is increasing. The outline gives the reactive power in a magnetic field. The second-quarter period, the path Gets the power from the magnetic field around the IR and turns it into electrical energy in a capacitor. All transient processes of making disturbances and energies occur synchronously in the field and in the path length is given by (frequency) oscillation.

A general link between the path and the field perturbations can be expressed by the following formula

$$\Psi I = Uq \qquad (14)$$

At the time of switching in the fields and in the path already exist previously experienced disturbances in the form of a voltage, charge current and magnetic flux, which was spent some energy. After switching the proportionality factors change, equation (4) to (12) turn into inequality. Synchronicity in the energy transformation processes and the circuit is broken, because the contour and field perturbation are parametric, additional processes EMF Balancing these disturbances and the reallocation of energies between the circuit and the fields. These processes occur simultaneously with the basic transition processes, the duration of which is specified by the settings of L and c.

Processes changes of parameters describes the linear second-order differential equations with periodic coefficients:

$$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + qd\left(\frac{1}{C}\right) = 0 \qquad (15)$$

$$\frac{d}{dt}\left(L\frac{dq}{dt}\right) + R\frac{dq}{dt} + \frac{q}{C} = 0 \qquad (16)$$

Capacity and inductance (L) from the differential sign is made, as are the variables, which can be described using a rectangular sines or cosines based on Fourier theory. Periodic hopping change these settings left side of equations does not become zero, that actually makes these equations in the equation of oscillations of a under the influence of a periodic exciting force in the form of parametric EMF. The magnitude of this EMF is difference arising in equations (15), (16) in the path before and after the commutation.

Thus, the essence of switching ways of getting MORE is that periodic changes of parameters of boundary and constantly displays the energy and power balance with the subsequent restoration of this balance that the perturbation is accompanied by changes and redistribution of energies between the circuit and the margin.

Switching mode excitation ETC electric fluctuations in special devices-reactive electric power generators (GRAHAM). And parametric machine they can be of two types-capacitive and inductive. The concept of capacitance GRAHAM presented in Fig. 1.

The device consists of a power transformer T2 with a core of ferromagnetic alloy linear magnetic induction of the magnetic field within the operating current in GRAHAM. The primary winding of the transformer 1 with inductance L in conjunction with thyristors connected via VS3 VS4 and S1 key, the main capacitor C2 forms a RLC circuit to which via thyristors VS1, VS2 connects an additional capacitor C1. The additional capacity of the condenser is 3 c condenser core capacity is 1 c. Parallel path connected Zener diodes VD2, VD4 with protection diodes VD1, VD3 and terminated resistors R1, R2.

Control electrodes and cathode thyristors are connected to the windings 3, 4, 5, 6 rectangular pulses generator (IG), collected at the base of the transformer T1, transistor VT1, capacitor C3 and R3, R4 resistor. To avoid parasitic electrical connections each thyristor is connected to a separate winding on the magnetic core so that thyristors VS1, VS2 offers positive control voltage pulse GAM, and VS3 VS4, Thyristors have negative momentum. Magnetic core transformer GAME is made of ferromagnetic material with a rectangular hysteresis loop. Selection of the parameters and characteristics of IG (windings 3, 4, 5, 6, R3, R4 resistor, capacitor, transistor VT1) duration of the positive momentum is set to 0.25 T, negative-0.5 T (T-period length fundamental frequency ω).

IG via key S4, rectifying bridge of diode VD5-VD8 and smoothing filter inductor consisting of L1 and capacitor C4 is connected to the secondary winding of the transformer 3 T2. To ensure that the IG has autonomous power source in the form of battery G1 charger base with the protecting diode VD10 concerning VD11. Battery via S3 and diode connected to the condenser C1 VD9. Load in the form of resistance R_l through key S2 is connected to the secondary winding of the transformer T2 2.

IT works as follows. When connecting the supply voltage through key S4 to the base transistor VT1 through resistor R3 is filed unlocking potential. The transistor is opened and through the primary winding of the transformer T1 is 1 current that charges the capacitor C3 and causes the buildup of magnetic flux in the magnetic core transformer. Appears when the voltage of the winding 1 translates into positive feedback winding 2, polarity which is such that it fosters the full opening of the transistor. When the collector current reaches its maximum, the buildup of magnetic flux in the transformer, the transformer windings the voltage polarity is reversed and a snowballing process of locking the transistor. Capacitor C3, razrâžaâs′ through the winding 1, generates a negative half period voltage (power ELECTRONICS Handbook ", radio and communications", Moscow, 1986).

Because the real shape of rectangular pulses PLAY a few trapecievidna, and semiconductor materials properties of thyristors are seen with a certain inertia, between the closing of one pair of thyristors and opening another pair is a short period of time, which eliminates the possibility of opening a pair of thyristors in the closure of another pair.

To make a preliminary analysis of the processes occurring in the operation of the GRAHAM, active power losses in the ohmic resistance of the oscillation circuit. In the initial state of all keys, the capacitors are discharged GRAHAM.

To make the generator work is closed, and then reset the S3 key. Capacitor C1 becomes from the battery of the G1 starting starting charge q_1, displays the path of the equilibrium position (second condition).

Closes key S4 and the IG. The starting charge is distributed among the parallel connected capacitors C1 and C2 in proportion to their capacities and in the path is the starting voltage U_{01}. Capacitor C1 becomes equal to 0.75 charge$_{q1}$, a capacitor C2 is charged 0.25$_{q1}$. By reducing the energy of the electric field of the total electric energy capacitors and circuit W_{e1} will be (6)

$$W_{e1} = 2CU_{01}^2 = q_1^2/8C \qquad (17)$$

This energy is distributed between the capacitors C1 and C2 in proportion to their capacity (W_{e1}'-the energy of the capacitor C1,$_{e1}$' W ' is energy capacitor C2)

$$W_{e1}' = 1,5CU_{01}^2 \qquad (18)$$

$$W_{e1}'' = 1,5CU_{01}^2 \qquad (19)$$

Closes the key S1 and start the life cycle of GRAHAM, which is divided into four phases. To facilitate analysis of these developments is expected immediately after the circuit key S1 is impulse control voltage, opening thyristors VS3 VS4 and Thyristors, VS1, VS2 is closed. Theoretically, any average fluctuation of electric or magnetic field could be a primary condition for the initiation of por, a feature of which is that the finite amplitude of voltage and current do not depend on their initial values.

Thyristors VS3 VS4, open circuit sets the starting voltage U_{01}. The initial electrical power path is defined by the expression (19). The first stage begins, which is equivalent to the capacity of the circuit is off, impedance, calculated according to the formula (10) equals $Z_{(c)}$, the basic frequency ω(3).

Timeline of the device is presented in Fig. 2 at which time deferred in shares of fundamental frequency period because in this diagram include the following designations changing quantities:

U_{Vs} -control voltage on thyristors;

C_{eq} -the total capacity of the circuit;

I-total current in the circuit path little;

U_{C1} -voltage on the capacitor C1;

U_{C2} -voltage on the capacitor C2;

Q-reactive electric power circuit.

Capacitor C2 is discharged via IR and thyristor VS4, the path appears in the current path, the electrical power is reduced and the magnetic field energy increases. Capacitor C1 is disconnected from the contours, as VS1, VS2 thyristors are closed. At the initial time of self-inductance ELECTROMOTIVE FORCE $(E)_{L1}$, preventing the rise of current and calculated according to the formula (13), has a maximum value, which is numerically equal to the primary first-phase voltage U_{01}.

After a time equal to 0, 25t, all electrical energy into magnetic energy circuit, charge 0, $25q_1$ moves from the capacitor C2 in the loop current, the voltage goes to zero. Current first phase I_1 reaches its maximum value, defined by the formula (8)

$$I_1 = U_{01} / Z_c \qquad (20)$$

Maximum magnetic energy at the end of phase W_{m1} will be according to the formula (7)

$$W_{m1} = LI_1^2 / 2 = W_{e1}'' \qquad (21)$$

This amount will increase the energy of the electric field.

All processes of phase occur synchronously, its duration is 0.25 m.

Control voltage IT changes its polarity, and when it is going through zero thyristor VS3 closes (current does not flow through it), and the thyristor VS4 remains open (current through it at the maximum).

Open thyristors VS1, VS2, and capacitor C1 that has charge of 0, $75q_1$ voltage U_{01} 5CU I and_{01} ^{2} connects to the path. The second stage begins, where the capacity of the circuit is increased to values of 4 c (1), the frequency is reduced to 0.5ω (3) impedance path drops to 0 $5Z_{,c}$ (10).

Capacitor C1 is discharged via IR and thyristor VS2. Thyristor switched back to DC the VS4 discharge and thyristor VS3 is closed, so along with the capacitor discharge C1 C2 capacitor voltage perezarâd is reversed polarity via a PC and open the DC thyristor VS4.

As a result of switching balance in equation (4) is broken and there is parametric EMF e_2, defined according to the following equation:

$$E_2 = 0,25_{q1} / C - q_2' / 4C = U_{01} - q_2' / C \qquad (22)$$

where q_2'-the equilibrium value of the charge of the second phase of the formed on the capacitor C2.

Under the influence of EMF $(e)_2$, is trim and contour the field perturbation and related changes of energy by increasing the current and charge in a circuit. The EMF is due to the fact that when you connect the capacitor C1 voltage U_{01} charge circuit with capacity of 4 c must match the q_1 ($4CU_{01}$), in reality it is equal to 0.75_{q1}. When discharge electric field energy should increase to $2CU_{01}{}^2$ (17), in fact it is increased by $1,_{01}5CU^2$ (18). The electrical power circuit must equal $q_1{}^2/8C$ actually it is smaller and is $(0, 75q_1)^2/8C$.

In the early phase of the EMF e_2 is the voltage U_{01}. After a time equal to 0, 25T, voltage on the capacitor C2 balances the EMF E_2 (U_{01} is zero), and the current increases to its second peak, determined by the formula (8)

$$I_2 = U_{01} / 0,5Z_c = 2I_1 \qquad (23)$$

Increase in current is related to the "infusion" in the path to the second phase, the additional energy from a capacitor C1 (W_{e1}') with its subsequent transformation into magnetic energy, so the maximum magnetic energy field and also increases and will be according to the formula (7)

$$W_{m2} = LI_2^2 / 2 = 2LI_1^2 = 4W_{m1} \qquad (24)$$

Increase the current EMF of self-induction impedes E_{L2}', is numerically equal to the voltage U_{01}. The capacitor C2 is the equilibrium charge q_2' which is determined on the basis of formulas (22) at zero parametric EMF:

$$q_2' = 0,25q_1 \qquad (25)$$

The capacitor C2 is reverse polarity voltage equilibrium U_2', determined by the formula (4)

$$U_2' = U_{01} \qquad (26)$$

In fact the commencement of the second phase voltage U_{01} was transformed via infrared from the condenser C1 to C2 capacitor, electrical energy at the time the balance has grown from zero to $0,_{01}5CU^2$ by reducing the energy of the electric field.

Changing the energy of the electric field has reached its equilibrium value (reduced by the amount of $0,_{01}5CU^2$). Charge circuit increased by 0, $25q_1$, i.e. perturbations and uravnovesilis′ fields. Accordingly, the electrical power circuit increased $(0, 25q_1)^2/8$ c and also reached its equilibrium value.

Then there is the inverse transformation of magnetic field energy into electric energy path over a period of time equal to 0, 25t. Completes the second phase of the simultaneous reduction in current and magnetic of the maximum values to zero. At the same time increasing and decreasing current, but doubled in comparison with the first phase of maximum current ($2I_1$) EMF of self-induction

(E) the$_{L2}$ at the end of the second phase will double in comparison with the EMF of self-induction began the first phase of the$_{L1}$ E (actually the EMF E_{L1} and$_{L2}$' summed). It will charge in parallel capacitors C1, C2 common reverse polarity voltage of the beginning of the third stage of the U_{23}equal to

$$U_{23} = 2U_{01} \qquad (27)$$

By separating charges in circuit conductors combined charge capacitors q_2 double and also make $2q_1$.

The total duration of the second phase is 0, 5T.

Control voltage again changes its polarity. When it goes through zero, and in the absence of current in the circuit all thyristors are closed, the capacitor C1 is disconnected from the circuit.

VS3 VS4, Thyristors are opened and begins the third stage cycle of GRAHAM. The processes occurring in the path field on the third and fourth stages, almost similar to the processes occurring at the first and second stages. The difference is only in the initial phase voltage is doubled, and the current flows in the opposite direction. At the end of the fourth phase of electric power capacitor increases in sixteen times in comparison with the beginning of the first phase, the amplitude of the voltage and current in one working cycle (one complete oscillation) are increasing four times.

To turn off, reset key S4, GRAHAM pulse generator stops and fluctuations in damped. All keys are returned to their original state.

The concept of induction GRAHAM is represented on fig. 3 and timeline of his work-fig. 4. Its difference from the capacitive GRAHAM is that instead of the capacitors C1, C2 are included respectively IR L1, L2, and instead of the primary winding of the transformer is connected the capacitor C1 with a capacity load and Connection with the IG is an electrical connection. In addition to inductance oscillations in the process changes the resistance of the circuit.

Inductance of L1 is IR 1 l, inductance INFRARED L2 is equal to 3 l. both IR share a closed magnetic core with linear magnetic induction of the magnetic field and included in the outline. This magnetic conductor on fig. 3 is not shown. The ratio of active resistances IR L1 and L2 of a significant impact on the analysis of processes.

One of the design options of induction GRAHAM is IR less inductance in IR with more inductance with no magnetic core (called "air" transformer). In this case, the role of the magnetic circuit is air that in terms of weight and dimensions, GRAHAM is the apparent advantage, but on the other hand, to obtain acceptable to health need frequencies GRAHAM condensers with large capacity.

Secondary winding IG 3, 4, 5, 6 are connected with thyristors in such a way that when negative pulse control voltage, VS3 VS4 thyristors are opened, and with a positive impulse are thyristors VS1, VS2. Selection of the parameters and characteristics of negative duration pulse of IG is set to 0, 25t, and positive-0, 125.

In the diagram (fig. 4) adopted the following values changing quantities:

U_{Vs} -control voltage on thyristors;

L_{eq}-total inductance circuit;

I-total current in the circuit path little;

U-voltage on the capacitor C1;

Q-reactive electric power circuit.

Casting induction GRAHAM in an operational state, and a preliminary charge of the capacitor C1 is performed in the same order as in the capacitive GRAHAM. By the beginning of the cycle, which is also being implemented in four phases, the capacitor C1 is the initial starting charge q_1 and set the starting voltage U_{01}. The path out of equilibrium.

The electrical power circuit W_{e1} in the beginning of the first phase is in accordance with the formula (6)

$$W_{e1} = q_1^2 / 2C = CU_{01}^2 / 2 \qquad (28)$$

Closes key S4 and the IG. Key S1 is closed and it is expected that the negative momentum is at the control voltage at thyristor VS3, VS4.

Thyristors VS3 VS4, open, begins the first phase of the inductance of the circuit is 3 l, impedance, calculated according to the formula (10), $Z_{(c)}$, the frequency ω (3).

Capacitor C1 is discharged via a PC L2 and thyristor controlled rectifier, VS3 VS4 is back in DC, and thyristors VS1, VS2 closed. The current in the circuit and the flux linkage in the increase and through time equal to 0.25 T, reach their maximum values I_1 and Ψ_1 defined formulas (8), (5)

$$I_1 = U_{01} / Z_c \qquad (29)$$

$$\Psi_1 = 3L_1 I \qquad (30)$$

The voltage on the capacitor is zero, charge q_1 moved into the circuit current, the electric power circuit in the magnetic field energy W_{m1}, is defined by the formula (7):

$$W_{m1} = 3LI_1^2/2 = \Psi_1^2/6L = W_{e1} \qquad (31)$$

Increase current and EMF of self-induction start prevents magnetic phase $(E)_{L1}$, maximum value which is numerically equal to the primary voltage U_{01}.

All processes of phase occur synchronously, its duration is 0, 25t.

Control voltage changes polarity. Thyristor VS4 closes (current does not flow through it), and the thyristor VS3 continues to remain open (current through it at the maximum).

Open thyristors VS1, VS2, and IR L1 connects to the path. Begins the second phase of the generator. The inductance of the circuit is reduced to 0.75 Z (2), the frequency is increased to 2 ω (3), the wave impedance is reduced to 0, $5Z_c$ (10).

Magnetic disturbance field Ψ_1 becomes more of a disturbance in the circuit, reduced to a value of 0, $75LI_1$. Balancing magnetic disturbances and the path is broken and there is parametric EMF $(e)_2$, which is equal to

$$E_2 = (\Psi_1 - 0,75L)/\Delta t \qquad (32)$$

where Δt is the duration of the transition (0, 0625T), the limited time of transition of the thyristors from closed to open State.

The EMF is designed in such a way that causes the increase of current in the circuit when the magnetic field. Essentially it consists of two EMF of self-induction in IR L1, L2. Under their influence the current decline slows down L2 IR and IR L1 current increases from zero to the maximum value.

Flux linkage is reduced, and the total current through the capacitor C1 is increased until the parametric EMF defined by the formula (32) is not equal to zero. In accordance with the law of conservation of energy transformation and change of magnetic field energy and path before and after switching, calculated according to the formula (7), the following equation

$$3LI_1^2/2 = 0,75LI_2^2/2 \qquad (33)$$

Solutions of this equation are the following equilibrium ratio of maximum current I_2 and magnetic- Ψ_2 in the second phase, compared to the first under the new proportional coefficient (0, 75 l):

$$I_2 = 2I_1 \qquad (34)$$

$$\Psi_2 = 0,5\Psi_1 \qquad (35)$$

Power curve is the second maximum of $2I_1$. The IR L1 current is 1.5 I_1, IR L2 0, 5 I_1.

Thus, the magnetic field energy is reduced and the path-is increasing, and at maximum value of current I_2 they reconcile and reach the value defined by equation (33).

At the same time recharge the capacitor C1 is reverse polarity voltage binding on it involved with the fluctuation of the charge.

The equilibrium value of the second phase of the charge q_2' is defined according to the following equation, composed of formulae (11), (34)

$$Kq_2' 2\omega = K2q_1\omega \qquad (36)$$

The capacitor C1 to the point at which the shock of the second maximum equilibrium concentration charge q_2', charging it to the equilibrium voltage polarity a second phase U_2' whose values are determined by the equation (36) and formula (4)

$$q_2' = q_1 \qquad (37)$$

$$U_2' = U_{01} \qquad (38)$$

Increase the current obstacle occurs at the beginning of the second phase of the EMF of self-induction E_{L2}' is numerically

equal to the largest U_2' (U_{-01}).

Completes the second phase of the simultaneous reduction in the current and maximum values of the magnetic-I_2, Ψ_2 to zero over a period of time equal to 0, 0625T. When increasing the amplitude of the current is in phase and equivalent inductance decrease current reduction and time compared to the time of his rise in the beginning of the first phase of the EMF of self-induction end second phase E_{L2} will increase by half compared to the EMF of self-induction began the first phase of

the$_{L1}$ E (actually E_{L1} and E_{L2}' summed). This will recharge the capacitor C1 reverse polarity voltage starting the third phase of the voltage U_{23}equal to

$$U_{23} = 2U_{01} \qquad (39)$$

Due to the separation of charges in the final charge of the capacitor circuit conductors q_2 double and also make $2q_1$.

The entire second phase duration 0, 125T torches magnetic energy fields is reduced and the electrical power circuit to the W value$_{e2}$ through reducing the energy of the electric field, determined by the formula (6)

$$W_{e2} = C(2U_{01})^{2/}2 = 2CU_{01}^2 = 4W_{e1} \qquad (40)$$

Control voltage GAME once again changes its polarity. Zero current in the circuit and the control voltage at zero all thyristors are closed, IR L1 is disconnected from the circuit.

The third and fourth phase of the GRAHAM is almost similar to the first and second phases of the operating cycle, GRAHAM. The difference is only in the initial phase voltage is doubled, and the current flows in the opposite direction.

At the end of the fourth phase of the electrical power circuit increases in sixteen times in comparison with the beginning of the first phase, the amplitude of the voltage and current in one working cycle (one complete oscillation) are increasing four times.

To turn off, reset key S4 and GRAHAM PLAY stops. Vibrations damped, all keys are given in the original position.

At the time of the termination of the work of the IG to the capacitors can remain high residual voltage, so the circuit prior to charge a capacitor (condenser) is plugged the diode VD9 protecting battery of the G1 from reverse current when GRAHAM.

In energy terms, the phenomenon of voltage and current amplitudes when PR is explained as follows. Energy output circuit in magnetic field W_1 and Energia, the returned path back into the box W_2, are expressed in the following formula:

$$W_1 = Q_1 t_1 \qquad (41)$$

$$W_2 = Q_2 t_2 \qquad (42)$$

where Q_1 -average amplitude of power during the transition path in the field of energy;

t_1 -the duration of the transition path in the field of energy;

Q_2 -average amplitude of power between energy fields in the return path;

t_2 -duration of the check-in process energy from the circuit.

In accordance with the law of conservation of energy and transformation:

$$Q_1 t_1 = Q_2 t_2 \qquad (43)$$

When festering free vibrations of t_1 is equal to t_2, so $Q_1 = Q_2$. The frequency of free vibrations and resonance frequency are the same.

When free damped oscillations of resonant frequency is less than the frequency of the vibrations, so t_2 t_1 and respectively$_2$ less Q Q_1. The amplitude of the power is reduced because part was spent on extensive losses and fluctuations in damped.

When OL t_2 $t_1$less, so Q_2 Q_1more. The amplitude of the power under certain conditions continuously increases.

As the numerical value of the amplitude of the electric power is the product of voltage and current amplitudes, increases the amplitude of the current, and then the amplitude of the voltage, which the perezarâžaûtsâ capacitors (or condensers). When continuous repetitions of the process of change is the continuous increase of the amplitude of the reactive electric power circuits, that is, its generation.

In the diagrams (fig. 2, 4) square shapes, limited power curves in positive and negative areas of graphics, are equal under the law of conservation and transformation of energy. The first jump of the amplitude of the power of capacitive GRAHAM is due to the fact that at the beginning of the second phase to the path connects a capacitor C2 and the voltage in the circuit jumps increases from zero to voltage U_{01}. The second leap power occurs in the middle of the second stage when the voltage polarity in the path with a straight back, as by that time the capacitor C2 has voltage U_{01} reverse polarity.

By the turn of the fluctuations of the electric energy of the capacitor (capacitor) circuit is increased by reducing the energy of the electric field. Thus, when energy intensity is MORE exchange between the circuit and the increasing quantities of magnetic and electric energies to higher levels.

The buildup voltage and current amplitudes in PR occurs exponentially, graphically displayed the parabola and is expressed by the following formula (without taking into account the ohmic resistance):

$$A_n = A_0 (p_{max} / p_{min})^n \qquad (44)$$

where A_n -n-th amplitude of fluctuations;

A_0 -amplitude oscillation of start-up;

p_{max} is the maximum value of the parameter;

$(p)_{min}$ -the minimum value of the parameter;

n-number of complete oscillations, starting with the first.

The expression $p_{max}p_{min}$ is the degree parameter changes and is denoted as m this value shows how many times increases the amplitude of current, voltage and power for one complete the resulting oscillation. Accordingly, for the period of the oscillations, which comes full cycle of mutual transformations of perturbations and related changes, these energies will increase in amplitude of$^{0.5}$ m.

However, in addition to magnetic and electric transformation in a real circuit there are thermal reaction and loss.

Based on the theory of and experimentation with parametric machines academicians L. I. Mandelshtam and N. D. Papaleksi identified energy excitation border ETC due to the presence of an active ohmic resistance and its attendant heat loss.

The third condition of ETC is expressed in the following inequality

$$h_{mod} > 2\Theta / \pi \qquad (45)$$

where h_{mod} -modulation depth (relative change parameter);

Θ -average logarithmic decrement damping core and parametric frequency.

Modulation depth parameter (relative change) is given by the following formula

$$h_{mod} = (p_{max} - p_{min})/p_{min} \qquad (46)$$

The left side of the inequality (45) characterizes the amplitude fluctuations in growth due to the changes to the parameter (increase of electrical power), right of-the attenuation caused by the presence of ohmic resistance (electric power consumption).

In General, the logarithmic damping ratio is determined by the formula

$$\Theta = \pi R / Z_c \qquad (47)$$

where R is ohmic resistance path.

When you increase the quantity R equal (45) turns into equity, thereby establishes a threshold of active resistance circuit, which may increase the amplitudes of the voltage and current. With expressions (44) (45) (46) the dependence of amplitudes resulting fluctuations from time t can be expressed by the following formula

$$A(t) = A_0(m - 2\Theta/\pi)^{t/Tr} \qquad (48)$$

where T_r-period of the resulting oscillations.

This period is defined as the arithmetic mean value of the main periods and parametric frequency. It is also consistent with and the resulting frequency.

Fig. 5 shows the curves of the amplitudes of the voltage in GRAHAM with different values of the ohmic resistance circuit, the ratio of which is defined by the following inequality

$$R_1 < R_2 < R_3 < R_4 \qquad (49)$$

When you increase the ohmic resistance decreases the amplitude and rate of rise of the largest active resistance of R_3, rise of the amplitudes is not, as in the formula (48) expression is equal to 1. This value is the threshold and active resistance. The largest resistance equal to R_4, the expression in the parentheses in the formula (48) is less than one, the amplitude decreases and fluctuations in damped. Therefore, when you increase the resistance parabolic dependence is smoothed, becoming first in line, and then in the èksponentnuû dependency.

This phenomenon was used for stationary machines parametric amplitude of parametric oscillations. As an additional load on the circuit include the consistent chain of filament lamps with dimmer function. Through experimentation, was chosen such an incremental loop resistance $R_{(a)}$in which all of the increase in output was being consumed by this resistance and further increase the amplitudes.

Unlike the parametric machines there are three ways to stabilize amplitude in GRAHAM. The ultimate goal of each method is to achieve a balance of reactive power generated by the power by dissipating excess power (consumption) or restrictions necessary to the health of GRAHAM.

Fig. 6 shows the vector diagrams of active, reactive and apparent power GRAHAM at free persistence of fluctuations, with free damped oscillations in parametric oscillations without active power consumption and parametric oscillations in the balance generated and consumed power. This chart outlines the following vector values:

Q_1 -maximum amplitude of reactive power during the transition of power from the circuit box in the discharge of the capacitor (condenser);

Q_2 -maximum amplitude of reactive power during the transition of power from the circuit during charging the condenser (capacitor) with parametric oscillations in a circuit without resistance;

Q_2'-maximum amplitude of reactive power during the transition of power from the circuit during charging the condenser (capacitor) circuit with resistance in parametric oscillations (reactive component of full power);

Q_2' '-maximum amplitude of reactive power during the transition of power from the circuit during charging the condenser (capacitor) circuit with resistance in free variation without change (reactive component of full power);

S_2 -maximum amplitude full power during the transition of power from the circuit at stabilization of parametric oscillation circuit with resistance;

S_2'-maximum amplitude full power during the transition of power from a field in the path of free oscillations in a circuit with resistance without changing the settings.

R-maximal amplitude of the total active power consumed in the circuit with Active losses stabilize amplitudes of parametric oscillations;

R '-maximum amplitude of active power consumed in the circuit with resistance in free variation without change;

ϕ -phase angle between current and voltage in a circuit.

When free oscillations in a circuit without active resistance Q_1 as well $Q_2^{'}$. Current and voltage amplitude remains constant reactive power generation does not occur (m equal to one).

With the introduction of the outline triangle vector resistance capacity is as follows:

$$S_2^{'} = Q_2^{''} + P^{'} \qquad (50)$$

The balance of power when the energies of the path in the box and back to the enforced, Q_1 as well $S_2^{'}$. But because of phase angle ϕ reactive component $Q_2^{''}$ is less than Q_1, so the initial charge and the voltage on the capacitor is not restored when the fluctuation and process variations fades.

When OL absolute amplitudes capacity during the transition period are determined by the following formula

$$Q_2(S_2) = Q_1 m^{0,5} \qquad (51)$$

Because of the resulting excess power and reactive power is generated, which at certain values of the amplitude of the voltage and current display of elements path (sample capacitor insulation or IR) in parametric machines with no incremental resistance.

The first way to stabilize the amplitudes in the GRAHAM is that parallel to the path connect Zener diodes resistors, which terminated with the Fig. 1 and 3 are identified as VD2 and VD4, R1 and R2, respectively. Zener diodes circuit is protected from reverse current diodes VD1, VD3. With this method, Zener voltage U_s the Zener diodes must be below the critical opening thyristors anode voltage U_a.

Amplitude stabilization occurs as follows. When the recharging of the condenser (capacitor) due to the EMF of self-induction, at the end of the second phase of the voltage in the circuit reaches a value of voltage stability concerning U_s. Zener diode is opened and, some charge, involved in the oscillation, passes through a chain of concerning, bypassing the condenser (capacitor). The excessive electrical power consumed on shunt resistors R1 and R2. The initial tension of the third and subsequent phases is limited to the value of U_s, (a) the amplitude of the current is limited by the size of current stabilization $I_s$equal to:

$$I_s = (U_s / Z_c) m^{0,5} \qquad (52)$$

where $Z_{(c)}$-wave impedance at the fundamental frequency.

This bypass path further build-up of the amplitudes of the voltage and current in the circuit, set fixed fluctuation amplitude, energy balance and inequality (45) turns into an equality. At the time of the stationary amplitude stabilization may be small low-frequency fluctuations due to fast work of Zener diodes and shunt resistors, and the hysteresis voltage stabilization at stabilitrone.

The relationship between the values of the extension (R_a) and shunt ($_{sh}$) resistances on the equivalence of their effects on the damping and stabilization of amplitude in the circuit is determined by the formula:

$$R_{sh} = Z_c^2 / R_a \qquad (53)$$

The balance of power in a stable amplitude vector form looks as follows (the entire increase of reactive power is spent on consumption)

$$S_2 = Q_1(Q_2^{'}) + P \qquad (54)$$

In terms of stable amplitude value effective reactive power Q_1($Q_2^{'}$) is given by the equation

$$Q_1(Q_2^{'}) = U_s^2 / 2Z_c \qquad (55)$$

The formulas (51), (55) vector expression (54) is converted into a scalar equation and the formula for calculating maximum efficient power consumption Graham (r) is as follows based on the geometric proportions of the triangle power

$$P = (U_S^2 / 2Z_c) m^{0,5} \cos \arcsin^{-0,5} \qquad (56)$$

Expression of cosarcsin $m^{-0.5}$ is cosϕ -utilization of capacity. From the formula (56) that when you increase the value of m increases as the amount of power consumed and the rate of its use.

The operating parameters and characteristics of the resistances of R1 and R2 is calculated based on the value of the excess capacity is wasted. Nominal value of these resistances $(R)_{sh}$ is calculated using the following formula (for a stock of electric strength insulation and dielectric capacitors the whole reactive power consumed only on shunt resistors)

$$R_{sh} = U_s^2 / P \qquad (57)$$

The load can be connected to the transformer connection GRAHAM (fig. 1) or the electrical connection (fig. 3). Regardless of the connection method, the load on the damping the same effect as the bypass circuit resistors R1, R2.

Maximum power consumption is defined as an expression of GRAHAM

$$P = P_m + P_e + P_c + P_a + P_s + P_q \qquad (58)$$

where P_m -magnetic losses associated with the vortical currents in the core PC and transformers, as well as the loss of the magnetic flux;

R_e -dielectric losses associated with the heating of dielectric and dielectric capacitor leakage current;

P_c -switching losses associated with currents in the diodes, thyristors and other semiconductors;

P_a -thermal losses in their active resistance circuit;

P_s -power on shunt resistors and load;

P_q -power pulse generator.

Power loss P_m, P_e, P_cP_a is functionally linked to the amplitudnymi values of current and voltage in the circuit and can be calculated according to existing methods. Power pulse generator (P_q) is conditionally constant that does not depend on the peak values and is defined only by the IG and its constitutive elements.

When connecting the load setting P_s under certain and calculated values for the rest of the above losses and cost is given by the expression

$$P_s = P_{sh} + P_1 \qquad (59)$$

where P_{sh} -excessive power dissipation in shunt resistors;

P_l -power to the load.

Power P_s in the above terms is constant and its magnitude P_{sh}, $P_{(l)}$ are variable. Because the shunt resistors and load are connected in parallel to the path with the highest load P_{sh} is zero, so P_s is P_l. If you disable the throttle

$P_{(l)}$ is zero, so P_s is P_{sh}.

Second and subsequent stabilization methods are that Zener diodes circuit diagram of GRAHAM are eliminated, and limit the voltage amplitude are critical opening thyristors anode voltage U_a. When the circuit voltage equal to $U_{of\ a}$, is the spontaneous opening of Thyristors, for which it is the anode, regardless of whether they control voltage. The capacitive GRAHAM during the first, there is a simultaneous discharge of capacitors C1, C2 through the PC and in the induction GRAHAM capacitor C1 is discharged simultaneously through both parallel linked PCs L1, L2. As a result, GRAHAM has free oscillations with parametric frequency which decay until the voltage in the circuit is less than the value of $U_{(a)}$. Further variations have been going with the resulting frequency. When you increase the voltage in the circuit above the level $U_{(a)}$ process of free vibrations decay again. Thus, stabilization of amplitude is decreasing by periodic changes to the parameter (m) to the unit and is accompanied by a systematic failure frequency and amplitude fluctuations in GRAHAM. To measure the power consumption in a formula (56) instead of the U_s is $U_{(a)}$.

A third way to stabilization is to use in transformers and IC cores of materials with nonlinear dependences of magnetic induction of the magnetic field strength (ferromagnetic materials with rectangular hysteresis loop). In this case the amplitude of the second peak current is limited by the current saturation of the core, which is determined with a high degree of credibility only by experience. By reducing the amplitude of the current rate of descent at the end of the second phase reaches a level that just the amount of EMF of self-induction whereby the recharge voltage of the capacitor (capacitor) reaches a fixed value and inequality (45) turns into an equality. This stabilization process is also accompanied by loss of frequency, while at the same time might be a ferrorezonansnyj effect. This method is also based on reduction of the degree of change (m).

When connecting a load, and its developments GRAHAM behaves like an ideal power source without a voltage drop on the internal resistance. Current-voltage characteristics of GRAHAM is represented on fig. 7. When the load is above the maximum value I_s fluctuations in the circuit ends, because at this point in the expression (45) sign of the inequality is reversed. Therefore, the load chain GRAHAM needs no protective devices, limiting the maximum load (fuses, circuit protection devices, etc.).

The frequency of 0.5 ω for the capacitive GRAHAM is the only frequency excitation ETC, which may be necessary for the functioning of the power increase. In the induction you can get PR GRAHAM higher orders. The ratio of primary and secondary inductances, such as 8 to 1, 15 to 24, 1 to 1 and so on, that is the square root of the sum of ratios of magnitudes inductors must be a natural number. The use of higher-order resonances to obtain more power consumed by the load compared to the resonance of the first order when almost identical dimensions and weight of the device. However, the use of such resonances is switching time Thyristors, which must be less than one eighth of the period parameter frequency (32), otherwise it becomes unsynchronized and comprehensiveness of primary and secondary transition in GRAHAM.

Condition of autonomy is expressed in the following inequality, GRAHAM, subject of the invention is done

$$P_q < P - P_m - P_e - P_c - P_a - P_l \qquad (60)$$

The power GAME are due to consumption of output power, and the battery of the G1 in this case provides only a preliminary charge a condenser (capacitor) and the functioning of the GAME in the start GRAHAM.

The claims

1. Switching method of parametric resonance excitation of electrical oscillations, that attached to the kolebatel'nomu boundary using thyristors connected additional inductor with inductance value three times less than or a capacitor with capacitance value three times higher than similar items outline that modifies the path during each Oscillation (inductance, capacitance, frequency variations, impedance), depending on the availability of positive control voltage to the thyristorssupplied to them at the time of the maximum current and the picture when it is zero.

2. the device for switching method of parametric resonance excitation electrical oscillations (reactive electric power generators), which includes the basic and additional RLC circuit

inductor with inductance capacitor with a smaller or three times face value three times higher than similar itemsand path-a path parallel with SCRS, managed by a particular pulse generator, which feeds or removes a control voltage to the thyristors and the duration of the positive control voltage is pulse for more inductance one eighth, for additional capacity, half of the main circuit oscillation frequency, and duration of negative impulse in both cases is a quarter of the period for the establishment of periodic changes in the contour of each parameter fluctuations and, thus contributing to the initiation of parametric resonance and electric power generation device.

PICTURES