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EXTRA HIGH FREQUENCY GENERATORS.

Abstract: *Ultra high frequency generators are used in the frequency range of 1...300 GHz and are created on the basis of semiconductor generator diodes, klystron, magnetron, runner and reverse wave lamps. Separate THOUGHT generators are optical quantum generators. Let's consider the semi-conductor OUCH generators used in communication system transmitters.*

Key word: *Wave, decimeter and long wave, transistor, autogenerator, diode, tunnel diode, source, circuit.*

Autogenerators based on elements of the descending section of VAX. If transistor autogenerators are used in the decimeter and long-wave part of the centimeter wave range, diode generators are widely used in the short centimeter and millimeter ranges. OYUCH diodes VAX used in such autogenerators have decreasing sections, so they have reverse resistance at operating frequencies. Generator diodes are tunnel diodes, fast-flying diodes and Gann diodes. Currently, a solid material "Quantim Welle-diode" with a new "quantum patch" semiconductor structure and negative resistance in a wide frequency range has also been developed [1,2].

Let's consider the principle of operation of the THOUGHT generator based on the tunnel diode [3]. A tunnel diode is a semiconductor diode with a very narrow potential barrier that prevents the movement of electrons. Therefore, it is observed that the n-shaped current depends on the voltage in the correct section of VAX.

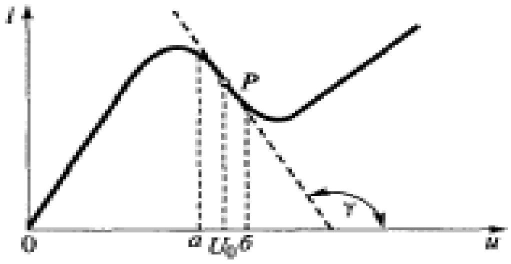

Figure 1. VAX of the tunnel diode

Figure 1 shows VAXi, which describes the dependence of the forward current of the tunnel diode on the positive bias voltage. In the descending a-b section, the differential resistance of the tunnel diode is negative, that is, R- = du/di = ctgg, where g- P corresponds to the VAX curve at the operating point i = f(u), the operating voltage u = U0, bo the angle of inclination of the test in the case of [4,5].

When connecting a tunnel diode with such a VAX to an oscillating circuit, high-frequency oscillations can be generated, and the resulting circuit becomes an autogenerator with internal feedback (Fig. 2) [6].

A simplified scheme of a generator based on a tunnel diode is shown in Fig. 2a. The oscillating circuit consists of L inductance and S0 specific capacitance of the diode, rk - circuit elements and equivalent resistance to losses in the diode, Eo - voltage shift in the diode. Blocking choke Lbl and capacitor Cbl (Cbl<< Co) prevent high frequency current from flowing through the DC circuit [7,8].

An alternate scheme of the oscillating circuit is shown in Fig. 2, b. The circuit is shunted by the negative differential resistance of the tunnel diode, and the alternating voltage uk moving in the circuit can be considered as an electric driving force. As a result of this movement, current iVD = - uk / R- flows through the diode [9].

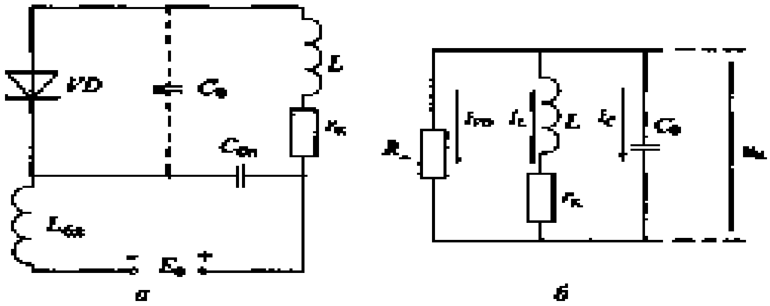

Figure 2. A generator based on a tunnel diode: a-simple scheme; b-substitute scheme.

The currents in the circuit iVD,iC,iL and the oscillating voltage uk are related to each other by the relationship determined by the first and second laws of Kirchhoff and Ohm:

$i_{VD} = i_C + i_L$;

$$i_C = C_o\, u_k / dt; \quad (1)$$

$u_k = r_k i_L + Ld\, i_L/dt.$

You can find what you want in these functions. For example, it is necessary to determine the current in the inductance network iL from the oscillation contour. To do this, by removing the current iC from the first of the equations (2), we determine the following from the first and second relations [10]:

$$i_{VD} = i_I + r_k C_0 \frac{di_L}{dt} + L^{C_0} \frac{d^2}{dt^2}. \quad (2)$$

At this time, the diode current

$$i_{VD} = -\frac{1}{R_-} u_k = -\frac{1}{R_-} \left(r_k i_L + L \frac{di_L}{dt} \right) \quad (3)$$

Equating the diode current in the next two expressions, we get the following differential equation:

$$\frac{d^2 i_L}{dt^2} + \left(\frac{r_k}{L} + \frac{1}{C_0\, R_-} \right) \frac{di_L}{dt} + \frac{r_k + R_-}{L C_0 R_-}\, i_{L=0} \quad (4)$$

We determine the conditions that cause the growth and decay of vibrations in the generator. In order for high-frequency oscillations to occur in the vibration system and its amplitude to increase, the coefficient of the first derivative in (3) should be negative. From here we determine the condition for the occurrence of vibrations

$$\frac{r_k}{L} - \frac{1}{C_0}\left|\frac{1}{R_-}\right| < 0 \qquad (5)$$

$$|R_-| < \frac{L}{r_k\,C_0} = R_0 = \rho Q = \frac{Q}{\omega_p\,C_0} \qquad (6)$$

In the last two relations, R- is the absolute value of the negative resistance of the tunnel diode, which depends on the amplitude of oscillations, Ro is the resonance resistance, in the last two relations, R- is the absolute value of the negative resistance of the tunnel diode, which depends on the amplitude of oscillations [11], Ro - resonance resistance, Q - quality, resistance of the oscillation contour is equal to r=√(L⁄C_0), Q - quality, resistance of the oscillation contour is equal to r=√(L⁄C_0).

The resistance of the tunnel diode | R- |= | R- (Uk)|, | R-(Uk)|= | R- (Uk st)| If we increase to = Ro, the amplitude of stationary oscillations in the autogenerator is set. If | R-(Uk)| if the resistance has a positive slope at the point of intersection of the Ro curve, the stationary mode of oscillations is stable [12].

From a physical point of view, the operation of such a generator can be described as follows: the negative resistance R- of the tunnel diode gives the generator circuit a large amount of energy compared to the energy released by the load resistance, which is calculated as resistance rk. The tunnel diode is considered a low-power device, and a current of I0 =1 mA flows through it in the operating mode, at the operating point of the VAX reduction section. But the power generated during loading is 20...30 mW. Such power is considered sufficient in a number of cases, and it will be possible to create generators with increased power [13].

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