Analysis of Microwave Energy Extraction Process at the Resonator with Controlled Transformation of Oscillation Modes[1]

S. N. Artemenko[*] **and V. S. Igumnov**[**]

Tomsk Polytechnic University, Tomsk, Russia
*e-mail: snartemenko@mail.ru
**e-mail: vladislavigumnov@yahoo.com
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Abstract—It is considered an operation of resonance microwave compressor with extraction of energy by means of controlled transformation of oscillations modes on a coupling window of the resonator with short-cut waveguide stub. Using dispersion matrix method with a device model we carried out the analysis of the extraction process in case of transformation of high-Q mode into down to the limit low-Q mode. There are obtained the expressions for description of the transient processes during accumulation and extraction processes. It is shown researched compressor is possible to shape the microwave pulses with controlled power, duration and envelope shape.

INTRODUCTION

Last 10–20 years it is of increased interest a passive way of power increase of the pulse microwave radiation, which is based on microwave pulse energy accumulation in the resonator and its fast extraction to the load [1]. The microwave compressors realizing this method are characterized by simplicity and low cost. At the same time they essentially increase pulse power of microwave radiation (up to 20–23 dB), allow to obtain high power of output pulses (0.001–1 GW) and they are possible to operate in case of high frequency of pulse repetition (0.1–1 kHz and higher) [2–6]. It provides the possibility of their application in different fields of science and technology. In particular, resonance microwave compressors are applied in accelerating equipment [4], research of influence of microwave pulses on electronic equipment and its elemental basis [5], in radio location [6] and the other fields of science and technology.

Due to operation principle of known compressors they shape microwave pulses with fixed gain, constant duration and envelope that restricts their functional possibilities.

In [7] it is experimentally shown the possibility of shaping of microwave pulses with regulated parameters in the compressor with energy extraction by oscillations transformation on a resonator coupling window with short-cut stub. The circuit of resonance compressor (Fig. 1) contains accumulating resonator *1*, energy extraction device *2*, T-joint stub *3*, inter-mode coupling *4* window, microwave switch *5*, movable stub short-cutter *6*, smooth junction with waveguide *7*.

Inherently, compressor (Fig. 1) is overdimensioned cylindrical resonator *1* with two operation oscillations modes, the first one is $H_{01(m)}$, where energy is accumulated, and additional one is $H_{11(n)}$, which is transformed into main one. Energy extraction is realized with a wave H_{11} of additional mode. Resonator end wall is used as an output, this wall is realized in form of smooth junction which is below-cutoff for a wave H_{01} of main oscillation mode and matched coupling output single-mode waveguide for additional mode wave H_{11}. Therefore transformation of high-Q mode into down to the limit low-Q one is realized, i.e. main operation mode is transformed into running wave of additional mode.

The stub as an element of inter-mode coupling is realized in form of T-joint or H-joint, placed outside the resonator and coupled with the resonator with direct arm. The second arm of T-joint is short-cut and its

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