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(54) **COMB GENERATING OPTICAL CAVITY THAT INCLUDES AN OPTICAL AMPLIFIER AND AN OPTICAL MODULATOR**

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(58) **Field of Search** 359/346; 372/22

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(57) **ABSTRACT**

A low-loss comb-generating optical cavity including an optical amplifier and a microwave-driven electro-optic modulator crystal, produces a comb of optical frequency sidebands having spectral lines equally spaced around the frequency of an input laser beam incident on the comb-generating cavity. The comb-generating cavity includes an input mirror movable along the beam propagation direction, and a fixed position output mirror located at time synchronous distances of both the input laser wavelength and modulation wavelength. The comb-generating cavity and its microwave driven modulator are in resonance with the input laser beam, and provide iterative or recirculating beam action that transfers the input optical frequency of the laser, sideband by sideband, to remote and precisely known comb frequencies offset from, and centered on, the input laser frequency. Optical parametric amplification within the comb-generating cavity extends the sideband or comb spectrum and sharpens the time domain impulse represented by the cavity circulating fields. A relatively short bandpass filter optical cavity receives the comb output of the comb-generating cavity and is made up of the fixed-position mirror and a third mirror movable along the beam propagation direction. Fine movement of the third mirror tunes the bandpass filter cavity, and preferentially couples out the power of one or more comb frequencies. An optional input optical cavity at the input side may increase efficiency. A self-oscillating configuration provides optical parametric oscillation.

55 Claims, 6 Drawing Sheets