16. The first of these two beam components, **25** or R1, comprises a beam that is directly reflected from the flat surface **21** of input mirror **18**, whereas the second of these two beam components, **26** or R2, comprises a cavity modulated beam that leaks out from comb-generating optical cavity **16**. A composite beam **27**, comprising R1+R2, is detected by a photodiode **28**. The electrical output **29** of photodiode **28** is provided as an input to cavity lock network **30**. Cavity lock network **30** operates to provide an electrical output **31** that energizes PZT **23**, to thus cause input mirror **18** to physically move as shown by arrow **32**. In this way, operation of cavity lock network **30** compares the phase and magnitude of directly reflected beam **25** to the phase and magnitude of leakage beam **26**, and generates an output **31** that is effective to move mirror **18** so that the quantity R1+R2 is minimized. In an embodiment of the invention, the beam minimizing physical position of mirror **18** was dithered by applying a dither frequency signal **32** to cavity lock network **30**, the dither length being relatively small (about $\frac{1}{10}^{th}$ of the cavity line width). Light beam **27**, or R1+R2, was then phase sensitive detected by cavity lock network **30** against dither frequency **32** to provide a cavity discriminator signal.

In FIG. **5**, a physically short dimension output, and tunable bandpass filter optical cavity, identified by broken lines **33**, is made up of above-mentioned fixed position mirror **19** and a third mirror **34**. Mirror **34** is identical to mirrors **18** and **19** in that it preferably has an identical lens substrate with an effective focal length of about 25 cm, a convex face **35** that is coated to be anti-reflective at the working wavelength, and a flat face **36** that is coated to have high reflectivity; for example, about 99.6% reflective.

In order to selectively tune bandpass filter optical cavity **33**, mirror **34** is mounted onto a slide stage **37** that is movable, for example manually, in the propagation direction as indicated by arrow **38**. Movement of slide stage **37**, as affected by a micrometer, operates to adjust the very short physical separation **40** that exists between the flat surface **21** of mirror **19** and the flat surface **36** of mirror **34**. This bandpass tuning of filter cavity **33** operates to cause a desired one, or a group of, the large number of comb frequencies that are present at beam location **39**, between mirror **19** and mirror **34**, to be provided as an output beam **41** from bandpass filter optical cavity **33**.

By way of example, distance **40** is adjusted to be in the micron range when a single comb frequency **41** is desired, and distance **40** is adjusted to be in the millimeter range when a group of comb frequencies are desired at bandpass filter output **41**. Coarse tuning of optical cavity **33** is produced by micrometer adjustment of slide stage **37**, whereas fine tuning of optical cavity **33** is produced by operation of PZT **42**.

As a feature of the invention, PZT **42** is mounted on the precision mechanism or motion stage **37** to allow spacing **40** to be varied from micro meters to a few millimeters. PZT **42** is energized so as to fine tune bandpass filter optical cavity **33** to a selected comb frequency or frequencies.

In an embodiment of the invention, the comb-generating cavity **16** that is formed by mirrors **18** and **19** has a finesse of about 400, a FSR of about 2 THz, a transmission efficiency of about 30%, and increased output power of the selected sideband **41** by a factor of 150.

In FIG. **5**, the portion **43** of the OFC's comb output **41** is monitored by a DC photodetector in the form of photodiode **44**, and the portion **45** of the OFC output **41** is sent to an avalanche diode **46** for heterodyne mixing with the output **47** of a cavity external, and tunable laser diode **48** that is tuned by operation of spectrascope and wavemeter **49**. Avalanche diode **46** operates to provide heterodyne detection of the selected OFC sideband **41**.

In an embodiment of the invention, operation of the apparatus of FIG. **5** provides enough resolution to resolve individual comb sidebands that are spaced about 10.5-GHz apart, and good SNRs were observed beyond sideband number **150**. For a still wider comb output, a wider FSR of the comb-generating cavity **16** or comb-line-selecting cavity **33**, will be appropriate.

In FIG. **5**, the efficiency of the OFC generator is improved by the use of the two mirrors **19**, **34** that make up a short filter cavity filter **33** that operates to permit the efficient escape of the selected comb sideband component(s) **41**. With limited power from He—Ne laser **10**, a beat signal **50** with a SNR of 20 dB and a 100 kHz bandwidth was produced.

As stated above, motion stage **37** and PZT **42** are used to position mirror **34** along propagation axis **70** in order to provide a peak or power output for a desired comb frequency (s) component **41** that is within comb output **39**. While a number of tuning schemes will be apparent to those of skill in the art, one scheme involves turning off microwave source **22**, such that the only frequency now within output **39** is that of reference frequency of laser **10**. The position of mirror **34** is then adjusted to seek a maximum signal output **41**. As a result, it is known that bandpass filter optical cavity **33** is now tuned to this reference frequency, and it is also known that this reference frequency is the center frequency of any subsequently-generated comb output **39**. The gap dimension **40** that now exists between mirrors **19** and **34** can be called a reference gap.

Microwave source **22** is now turned on, and a multi-frequency comb output **39** is now generated. It is known that the comb frequencies are spaced by the 10.5-GHz frequency of microwave source **22**. Thus, a desired one of the frequencies within comb output **39** can now be found by moving mirror **34** and counting a precalculated number of maximum/minimum signal intensities in output **41**, whereupon it is known that the desired sideband frequency is now being passed by bandpass filter optical cavity **33**.

It is also known that when a desired sideband frequency **41** is higher than reference frequency **11**, reference gap **40** between mirror **19** and **34** must be decreased in size in order to count and thus find that higher frequency sideband, and it is known that when a desired sideband frequency **41** is lower than reference frequency **11**, reference gap **40** between mirror **19** and **34** must be increased in size in order to count and thus find that lower frequency sideband.

In embodiments of the invention, but without limitation thereto, an optical parametric amplifier utilized was a $MgO:LiNbO_3$ crystal heated to about 108-degrees centigrade, to provide phase matching at 1064 nanometers when pumped by a CW 532 nanometer pumping beam.

The invention has been described in detail while making reference to various embodiments thereof. Since it is known that others skilled in the art will readily visualize yet other embodiments that are within the spirit and scope of this invention, the above detailed description is not to be taken as a limitation on the spirit and scope of this invention.

What is claimed is:

1. Comb generating apparatus comprising:

an input mirror and an output mirror physically spaced from each other to define a comb-generating optical cavity having a propagation axis;

each of said input and output mirrors having a beam entry surface and a beam exit surface, said beam exit surface