but microwave amplifiers can be designed and built with a noise level of only 0.1 pW for a 20 MHz bandwidth. Thus a transmitted signal of 100 mW can be attenuated on the round trip path by up to 120 dB before the signal-to-noise ratio drops to 1. Using frequencies near 100 GHz, would provide a narrow-beam, ≈1° wide, for an antenna with only a 4-inch aperture.

[**0031**] An embodiment of a sound detection system in accordance with the present invention configured to detect vibrations of an aluminum foil is shown in **FIG. 3**. In the illustrated configurations, the sound detection system **10**" is positioned a distance of approximately 1 foot from an aluminum foil **80**. A speaker **82** is positioned on the other side of the foil and directs sound pressure waves at the foil. The speaker is capable of generating sound because it is connected to a radio **84**. The sound detection system **10**" can detect movement of the foil by directing an RF beam at the foil.

[**0032**] In the illustrated embodiment, the sound detection system **10**" includes an RF synthesizer **40**' connected to an antenna **50**' via a directional coupler **52**'. The directional coupler is also connected to a low noise amplifier **54**', which in this instance is implemented using MMIC technology. The output of the low noise amplifier is provided to a harmonic mixer **56**', which is connected to an RF oscillator **58**' and a second amplifier **60**'. An output from the second amplifier is provided to a narrow band filter **62**', which in turn provides an output to a diode detector **64**'. The diode detector is connected to a sampling scope **86**, which is connected to a data acquisition computer **66**'. In one embodiment, the RF beam generated by the sound detection system is a monochromatic, has a frequency of 18 GHz and a amplitude that is unmodulated. The sound detection system **10**" observes reflections of the RF beam from the aluminum foil using the antenna **50** and the signal is processed in accordance with the description above. In several embodiments, the power of the RF beam can be of the order of several milliwatts. The reflected signal can be fed to the low-noise 18 GHz amplifier **54**'. The signal can then be heterodyned down to 1 GHz and bandpass filtered to 2 MHz to reduce the overall system noise. The detected signal can then be displayed on the sampling scope **86** or simply digitized and stored on a computer. Simultaneously, the audio signal from the radio can also be digitized and stored for comparison with the microwave response.

[**0033**] A graph showing the amplitude of audio signal incident on the aluminum foil shown in **FIG. 3** is illustrated in **FIG. 4A**. The graph **100** charts **102** the signal amplitude as a function of time. The signal itself was generated by tuning the radio **84** shown in **FIG. 3** to a talk radio station.

[**0034**] A graph showing the output of the sound detection system illustrated in **FIG. 3**, when the audio signal shown in **FIG. 4A** is incident on the aluminum foil **80** shown in **FIG. 3**, is illustrated in **FIG. 4B**. The graph **104** charts **106** the output obtained by the sound detection system in accordance with the process described above against time.

[**0035**] As discussed above, embodiments of sound detection systems in accordance with the present invention can detect sounds through barriers. In one instance, a plywood barrier having a thickness of 0.75 inches was interposed between the sound detection device **10**" and the aluminum barrier **80** shown in **FIG. 3**. A graph **108** charting **110** the audio signal incident on the barrier is shown in **FIG. 4C**. A graph **112** charting **114** the output generated by the sound detection system in accordance with the processes of the present invention, when the RF beam generated by the sound detection system must pass through the plywood barrier described above, is shown in **FIG. 4D**. The microwave beam can penetrate the plywood barrier **80** and be modulated by the vibrations of the foil caused by the audio signal pressure waves.

[**0036**] An embodiment of a sound detection system in accordance with the present invention that includes separate antennas for illuminating a subject and for receiving reflections is illustrated in **FIG. 5**. The remote detection system **10**'" is similar to the embodiment illustrated in **FIG. 1**, except that a first antenna **180** is used to generate an electromagnetic signal beam and a second antenna **182** is used to detect the reflected electromagnetic signal beam.

[**0037**] While the above description contains many specific embodiments of the invention, these should not be construed as limitations on the scope of the invention, but rather as an example of one embodiment thereof. Many other variations are possible, including implementing sound detections systems in accordance with the present invention using planar antennas and MMIC manufacturing techniques. In addition, vibrations of objects associated with pressure wave other than sound pressure waves can be monitored. Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their equivalents.

What is claimed is:

1. A device for detecting audible sound, comprising:

an RF transmitter configured to generate an RF signal having a frequency of at least 100 MHz and an unmodulated amplitude;

an RF receiver configured to receive a reflected RF signal comprising an RF carrier having the same frequency as the generated RF signal that is amplitude modulated by an information signal; and

a signal processor configured to extract audio frequency information from the amplitude of the reflected RF signal.

2. The device of claim 1, wherein the RF transmitter comprises an RF synthesizer coupled to an antenna.

3. The device of claim 2, wherein the antenna is a planar antenna.

4. The device of claim 2, wherein the antenna is a waveguide horn antenna.

5. The device of claim 1, wherein the RF receiver comprises:

an antenna;

a low noise amplifier coupled to the antenna;

a harmonic mixer connected to an output of the low noise amplifier and to an RF oscillator;

a second amplifier connected to an output of the harmonic mixer;

a narrow bandpass filter connected to an output of the second amplifier; and