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A High Power Microwave Zoom Antenna with Metal Plate Lenses

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Background: Historically, the term "zoom antenna" has been erroneously applied to reflector antennas that are used to broaden the beam through a defocusing effect; there are a number of these types of antennas described in available literature and existing patents. These are not technically zoom antennas. While Cassegrain and Gregorian (reflector) antennas can produce a collimated beam of electromagnetic energy; they cannot provide continuously variable diameter of this collimated beam. True zoom capability cannot be achieved with any of these reflector type antennas.
A true high power microwave (HPM) zoom antenna therefore requires the use of lenses. Dielectric lenses are not a good option for HPM applications because they are lossy at high frequencies and because they become prohibitively heavy at lower frequencies on the order of a few gigaherz. Metal plate lenses are particularly well-suited to the HPM zoom antenna application. The concept of the metal plate lens was proposed by W.E. Kock in the 1940's; however, it has found limited application since. The tolerance of this type of lens is much higher than the surface contour requirements of a parabolic reflector. This is a major benefit for a practical system that can be implemented in the field. Implementing these lenses in a high power microwave zoom antenna has not been proposed or demonstrated prior to this work.

Technology Description: A true zoom antenna produces a collimated beam of electromagnetic (EM) energy with continuously variable diameter. This type of antenna provides beam control in terms of spot size and power density on target. A true high power microwave (HPM) zoom antenna greatly extends the range of an HPM source and is useful for such applications as target acquisition and tracking, communications, and electronic attack. Until now, true zoom antenna capability for high power microwave applications did not exist.
The zoom antenna concept presented herein consists of a horn feed antenna and two metal plate lenses. This is a narrowband antenna with approximately 10% bandwidth which produces a linearly polarized collimated beam with continuously variable diameter (achieved by axial translation of the lenses relative to each other and relative to the feed horn). The zoom antenna can be designed for a wide range of frequencies from hundreds of megahertz (MHz) to tens of gigahertz (GHz). It has excellent power handling capability: ranging from tens of megawatts (MW) at 10GHz to several gigawatts (GW) at 1GHz.

Key Advantages:

- Extended range
- Full beam control
- High Power Application