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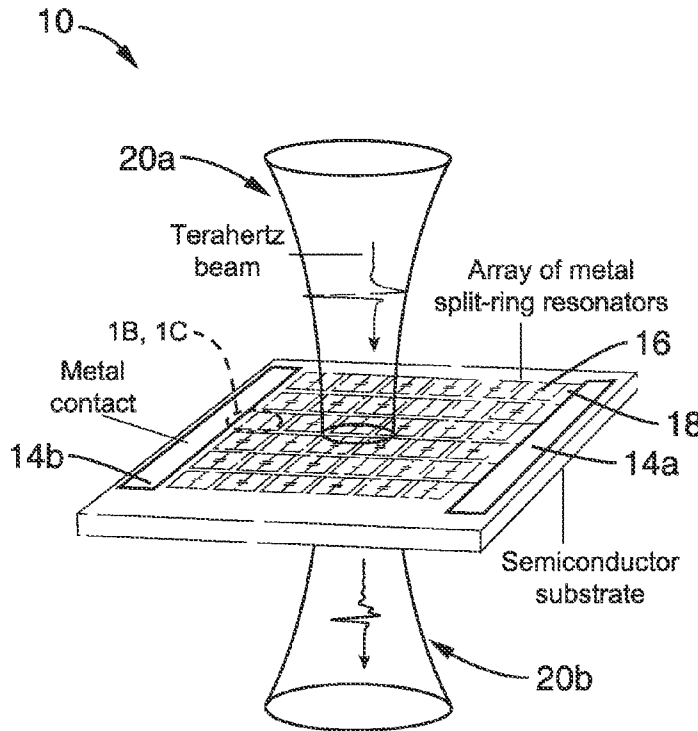
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(54) **Title:** ACTIVE TERAHERTZ METAMATERIAL DEVICES



**FIG. 1A**

(57) **Abstract:** Metamaterial structures are taught which provide for the modulation of terahertz frequency signals. Each element within an array of metamaterial (MM) elements comprises multiple loops and at least one gap. The MM elements may comprise resonators with conductive loops and insulated gaps, or the inverse in which insulated loops are present with conductive gaps, each providing useful transmissive control properties. The metamaterial elements are fabricated on a semiconducting substrate configured with a means of enhancing or depleting electrons from near the gaps of the MM elements. An on to off transmissivity ratio of about 0.5 is achieved with this approach. Embodiments are described in which the MM elements incorporated within a Quantum Cascade Laser (QCL) to provide surface emitting (SE) properties.

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<b>C DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
Y	US 7,113,534 B2 (UNTERRAINER et al) 26 September 2006 (26 09 2006), entire document especially col 3, ln 10-16, col 3, ln 32-41, col 4, ln 35-40, and col 6, ln 65-67	1-19
Y	US 5,017,897 A (OOI et al) 21 May 1991 (21 05 1991) entire document especially col 1 ln 39-47)	1-20
Y	US 5,903,050 A (THURAIRAJARATNAM et al) 11 May 1999 (11 05 1999), entire document especially col 2, ln 63-67	9
Y	US 4,982,243 A (NAKAHATA et al) 01 January 1991 (01 01 1991) entire document especially col 3, ln 32-41	14
Y	US 5,936,989 B2 (CAPASSO et al) 15 August 2006 (10 08 12006) entire document especially col 5, ln 7-12	17
Y	US 6,026,108 A (LIM et al) 15 February 2000 (15 02 2000) entire document especially col 1, ln 16-19, col 11, ln 8-14	19
Y	US 5,374,564 A (BRUEL) 20 December 1994 (20 12 1994) entire document especially col 2, ln 5-13	18
Y	US 2006/0092079 A1 (DE ROCHEMONT) 04 may 2006 (04 05 2006) entire document especially (para [0022]-[0023])	20
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