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**Mori et al.**

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(54) **ANTENNA MODULE AND COMMUNICATION DEVICE EQUIPPED WITH THE SAME**

(56) **References Cited**

U.S. PATENT DOCUMENTS

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9,715,609 B1 \* 7/2017 Fink ..... H01Q 25/00  
2008/0144689 A1 \* 6/2008 Crouch ..... H01Q 3/26  
372/57

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(Continued)

FOREIGN PATENT DOCUMENTS

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JP 2004-88508 A 3/2004  
JP 2004-254179 A 9/2004

(Continued)

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OTHER PUBLICATIONS

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(57) **ABSTRACT**

An antenna module includes a radiation element having feeding points, feeding wiring lines, and directional couplers. The feeding wiring line transmits a radio frequency signal from the RFIC to the feeding point. The feeding wiring line transmits a radio frequency signal from the RFIC to the feeding point. The directional coupler detects a radio frequency signal to be supplied to the radiation element through the feeding wiring line. The directional coupler detects a radio frequency signal to be supplied to the radiation element through the feeding wiring line. A polarization direction of a radio wave to be radiated with the radio frequency signal supplied to the feeding point is different from a polarization direction of a radio wave to be radiated with the radio frequency signal supplied to the feeding point.

(30) **Foreign Application Priority Data**

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CPC ..... **H01Q 1/2208** (2013.01); **H01Q 1/2283** (2013.01); **H01Q 1/38** (2013.01)

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