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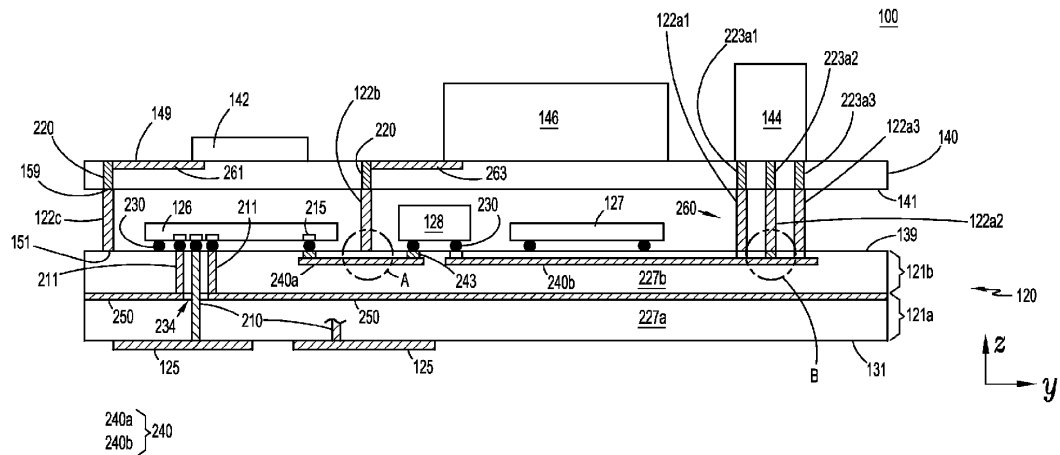


FIG. 2

(57) Abstract: An antenna apparatus includes an antenna substrate with opposite first and second surfaces; and a RGB having opposite first and second surfaces. Antenna elements are disposed at the first surface of the antenna substrate. Electrically conductive columns, each having a first end attached to the second surface of the RGB and a second end attached to the second surface of the antenna substrate, secure the RGB to the antenna substrate and provide an electrical interconnect between the RGB and the antenna substrate. RFIC chips are each attached to the second surface of the antenna substrate and are coupled to the antenna elements. At least one circuit element is attached to the first surface of the RGB and electrically coupled to at least one of the RFIC chips through at least one of the electrically conductive columns.

[Continued on next page]

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