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**Cuk**

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(54) **STEP-DOWN CONVERTER HAVING A RESONANT INDUCTOR, A RESONANT CAPACITOR AND A HYBRID TRANSFORMER**

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(58) **Field of Classification Search** ..... **323/224, 323/233, 288, 290, 293, 259**  
See application file for complete search history.

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(57) **ABSTRACT**

Unlike buck converter and tapped-inductor buck converters, which use only inductive energy transfer, the present invention employs the capacitive energy transfer in addition to inductive energy transfer. The hybrid transformer performs the double duty simultaneously: transfers the input inductive energy storage to the load through a tapped-inductor turns ratio  $n$  but also transfers the resonant capacitor discharge current to the load during OFF-time interval amplified by turns ratio  $m$  of the hybrid transformer.

Despite the presence of the resonant inductor current during the OFF-time interval, the output voltage is neither dependent on resonant component values nor on the load current as in conventional resonant converters but depends on duty ratio  $D$  and turns ratio  $n$  of the hybrid transformer. Hence a simple regulation of output voltage is achieved using duty ratio control.

**20 Claims, 43 Drawing Sheets**

