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[54] **HIGHLY EFFICIENT MULTI-FREQUENCY VOLTAGE REGULATING CIRCUIT INCORPORATING A MAGNETIC FIELD POWER SENSOR AND PROGRAMMABLE MAGNETIC FIELD DETECTION**

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[58] **Field of Search** ..... 323/274, 275, 323/276, 277, 911; 363/50, 52, 55, 56; 324/200, 225, 117 R

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,070,699	1/1978	Einbinder	363/55 X
4,752,733	6/1988	Petr et al.	324/225
5,662,694	9/1997	Lidman et al.	607/60

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[57] **ABSTRACT**

The highly efficient multi-frequency voltage regulating circuit is capable of converting magnetic field energy to electrical energy for charging either a battery or an energy storage device such as a capacitor. The invention provides a magnetic field sensor circuit that measures the strength of incoming magnetic field energy with respect to a reference current. The invention also provides for a programmable magnetic field detection circuit which is used to adjust the detection level of the inductor-capacitor magnetic field converter circuit. A discharge expediter circuit is provided to improve the efficiency of the magnetic field converter circuit by discharging excess energy.

26 Claims, 6 Drawing Sheets

