United States Patent [19]

Tuttle et al.

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[54] **MODULATED SPREAD SPECTRUM IN RF IDENTIFICATION SYSTEMS METHOD**

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[51] Int. Cl.^{6} **H04B 1/69**

[52] U.S. Cl. **375/200**; 375/208; 375/367; 370/18

[58] Field of Search 375/200, 202, 375/203, 204, 208, 367; 370/18, 19, 107

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[57] **ABSTRACT**

A method for RF communication between transceivers in a radio frequency identification system that improves range, decreases multipath errors and reduces the effect of outside RF source interference by employing spread spectrum techniques. By pulse amplitude modulating a spread spectrum carrier before transmission, the receiver can be designed for simple AM detection, suppressing the spread spectrum carrier and recovering the original data pulse code waveform. The data pulse code waveform has been further encrypted by a direct sequence pseudo-random pulse code. This additional conditioning prevents the original carrier frequency components from appearing in the broadcast power spectra and provides the basis for the clock and transmit carrier of the transceiver aboard an RFID tag. Other advantages include high resolution ranging, hiding transmissions from eavesdroppers, and selective addressing.

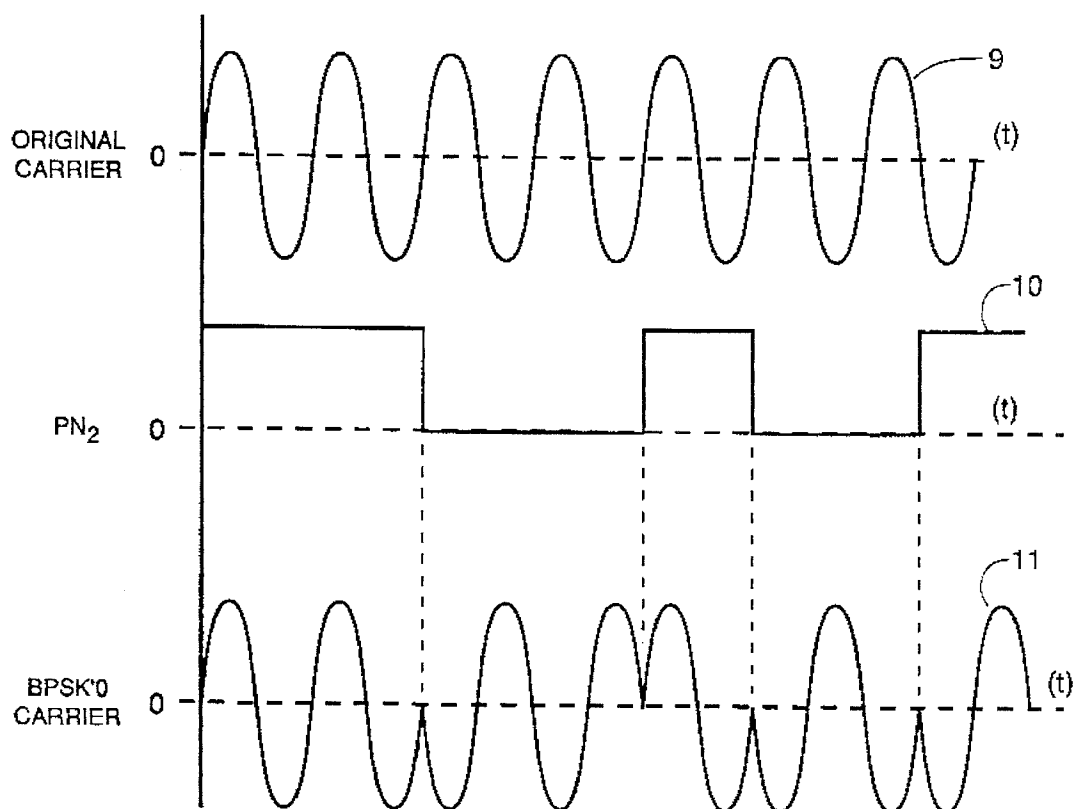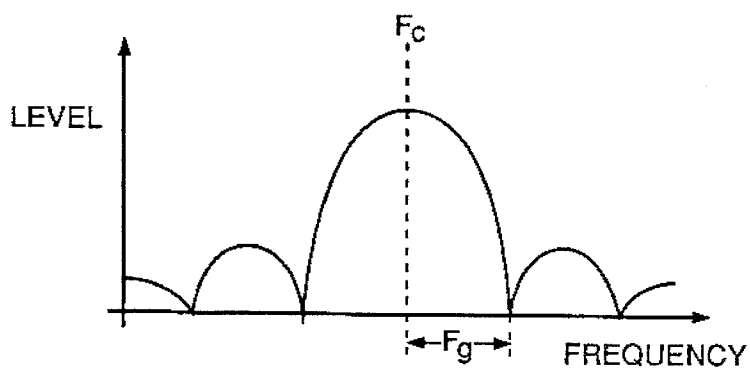**3 Claims, 10 Drawing Sheets**
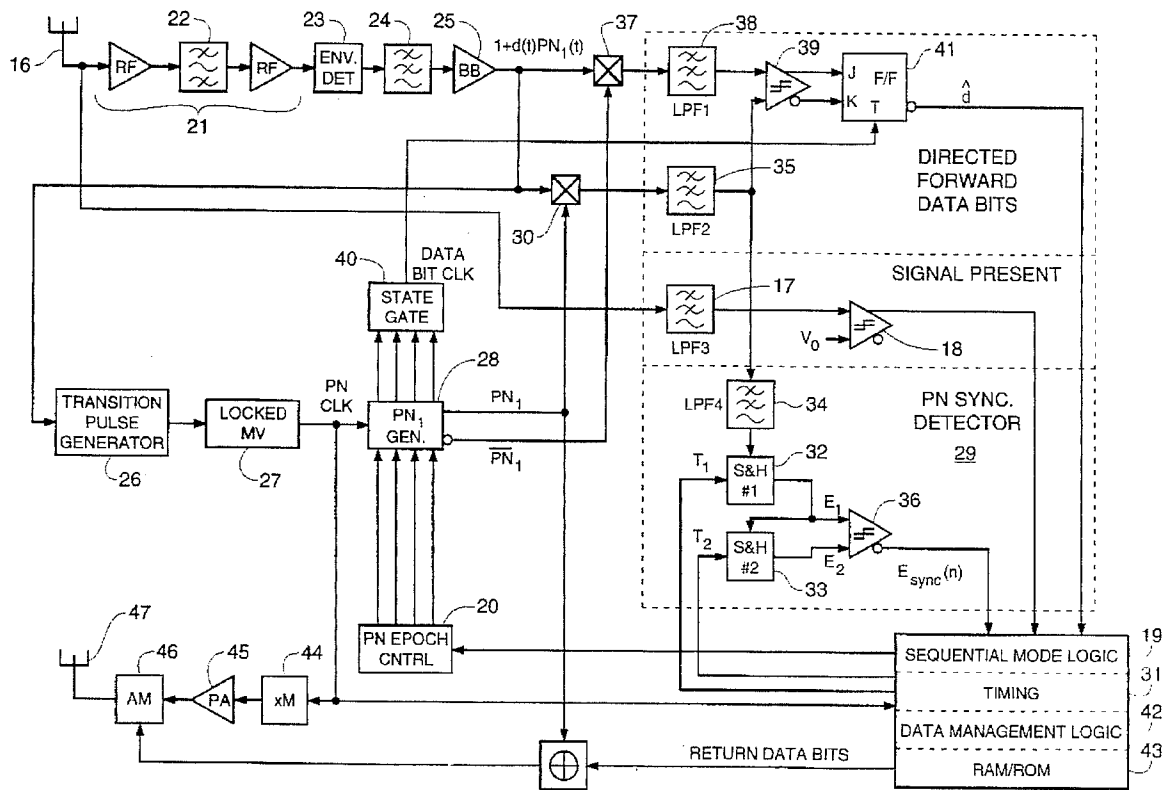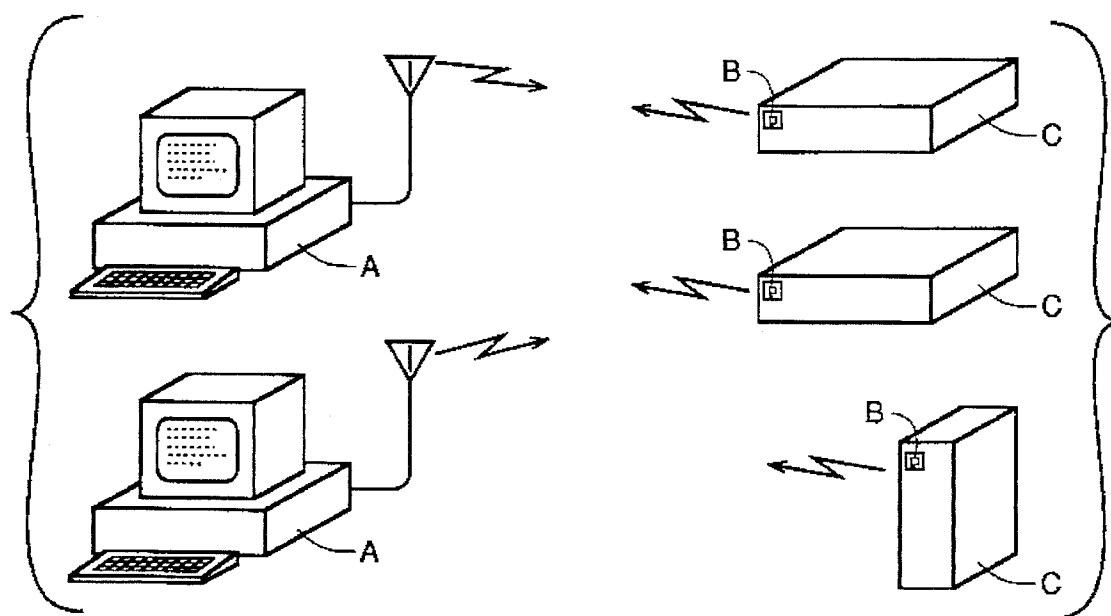
FIG. 1
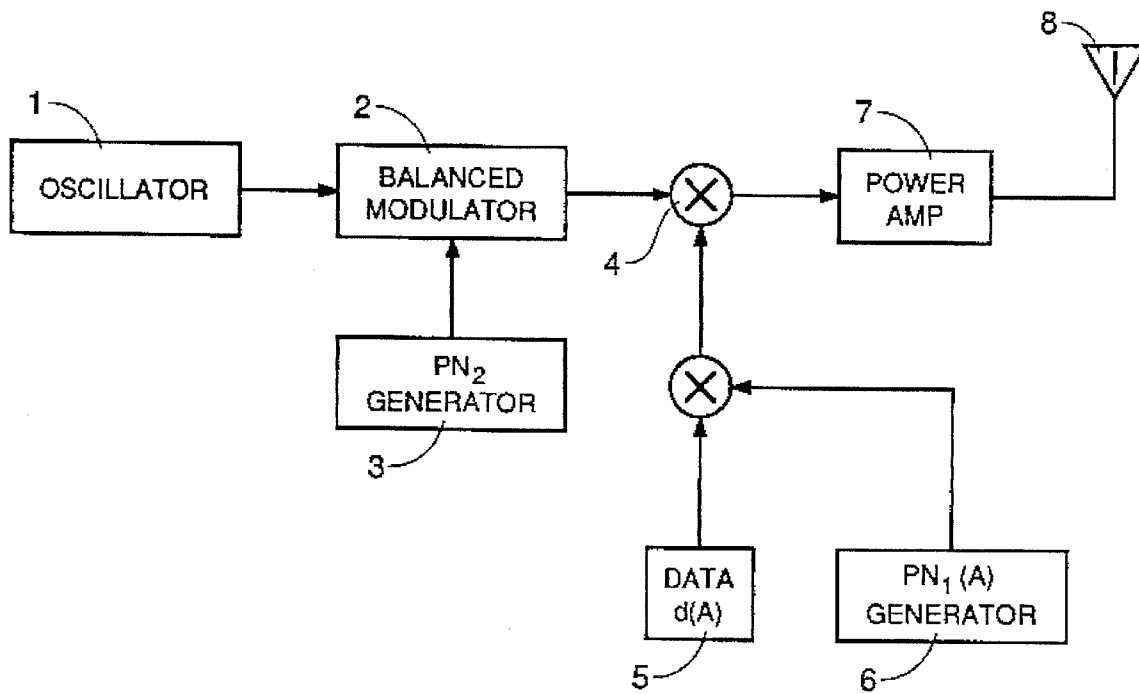
FIG. 2

FIG. 3

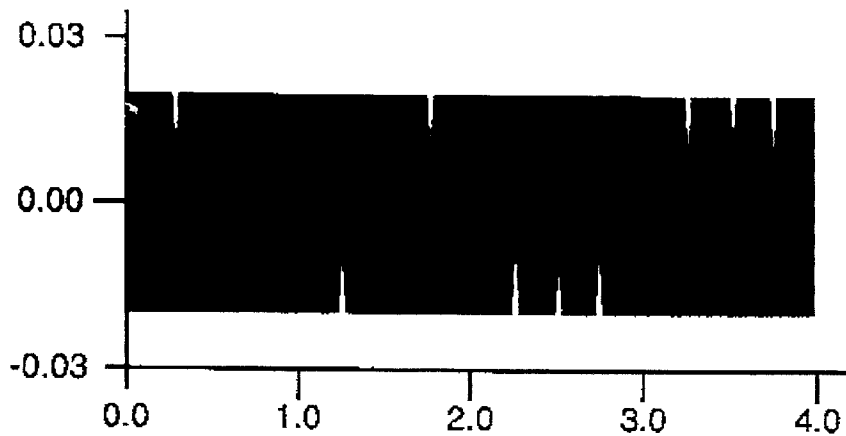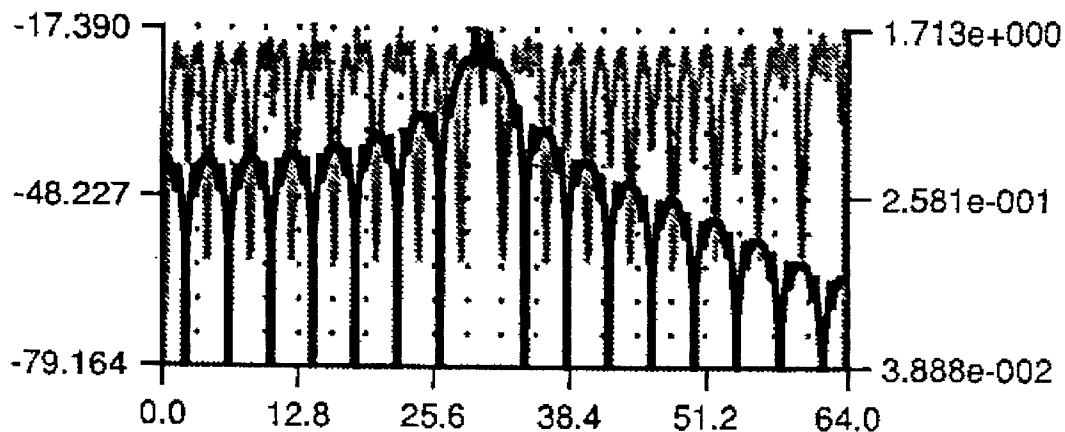
FIG. 4

BIPHASE CARRIER MODULATION

$$\cos\left[\omega_0 t + \frac{\pi}{2} PN_2(t)\right]$$

FIG. 5A

BIPHASE CARRIER MODULATION SPECTRUM

FIG. 5B

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