United States Patent [19]

Stautner et al.

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[54] **AUDIO COMPRESSION SYSTEM EMPLOYING MULTI-RATE SIGNAL ANALYSIS**

[75] Inventors: **John P. Stautner**, Wellesley Hills; **William R. Morrell**, Somerville; **Sriram Jayasimha**, Boston, all of Mass.

[73] Assignee: **Aware, Inc.**, Cambridge, Mass.

[21] Appl. No.: **948,147**

[22] Filed: **Sep. 21, 1992**

[51] Int. Cl.⁶ G10L 7/04
[52] U.S. Cl. 395/2.14
[58] Field of Search ....: 381/29–35; 395/2.1, 2.38, 2.14, 2.15, 2.39; 364/724.01, 724.1

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Primary Examiner—David D. Knepper
Attorney, Agent, or Firm—McCubbrey, Bartels & Ward

[57] **ABSTRACT**

The compression system utilizes sub-band analysis filters whose bandwidths are chosen to approximate the critical bands of the human auditory system while avoiding the aliasing problems encountered in QMF filter banks designed to provide similar band splitting. One embodiment of the invention may be implemented on a digital computer. The computational requirements of the synthesis filters may be varied in response to the available computational resources of the computer, thereby allowing a single compressed audio signal to be played back in real time on a variety of platforms by trading off audio quality against available computational resources. Similar trade offs can be made in compressing an audio signal, thereby allowing a platform having limited computational capacity to compress a signal in real time.

5 Claims, 11 Drawing Sheets
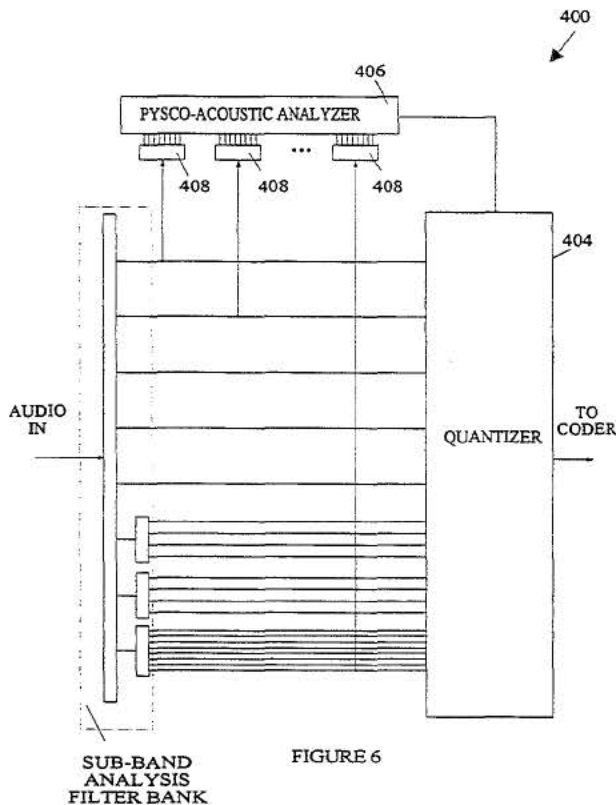
FIGURE 6
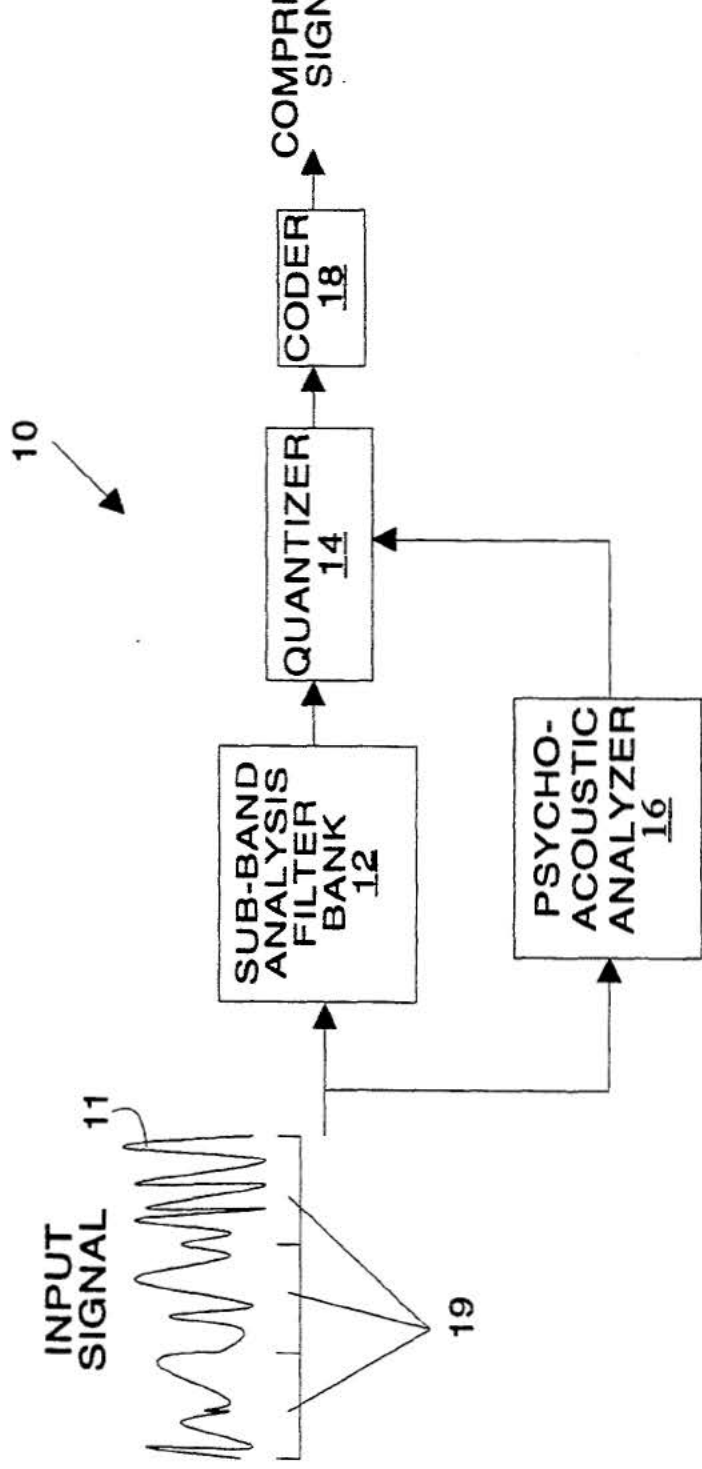
FIGURE 1
(PRIOR ART)

INPUT SIGNAL →

31

FILTER BANK

30

LOWEST

HIGHE

BANDS 18-22

32

FILTER BANK

BANDS 1-8

33

FILTER BANK

BANDS 9-13

34

FILTER BANK

BANDS 14-17

FIGURE 2

FIGURE 3

301

312

313

|← M →|

FIGURE 4

375

376

377

AUDIO
SIGNAL

MODULATION
SIGNAL

LOW-FREQ.
BANDPASS
FILTER

FILTERED
AUDIO
SIGNAL

FIGURE 5(a)

350

320

M
AUDIO
SAMPLES

W-SAMPLE SHIFT REGISTER

GENERATE
2M POLYPHASE
COMPONENTS

322

325

controller

330

clock

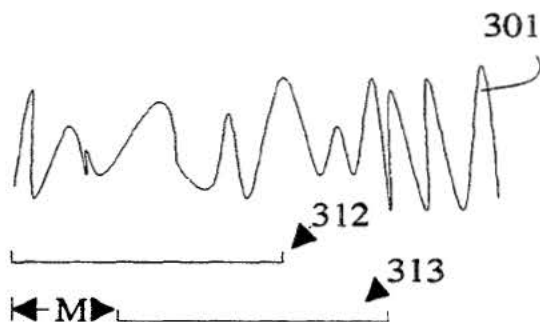MATRIX MULT.
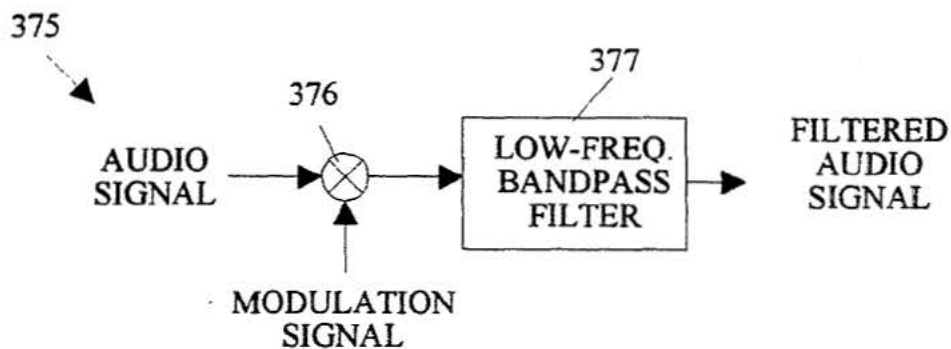TO GENERATE
M SUB-BAND
COMPONENTS

324

S_i
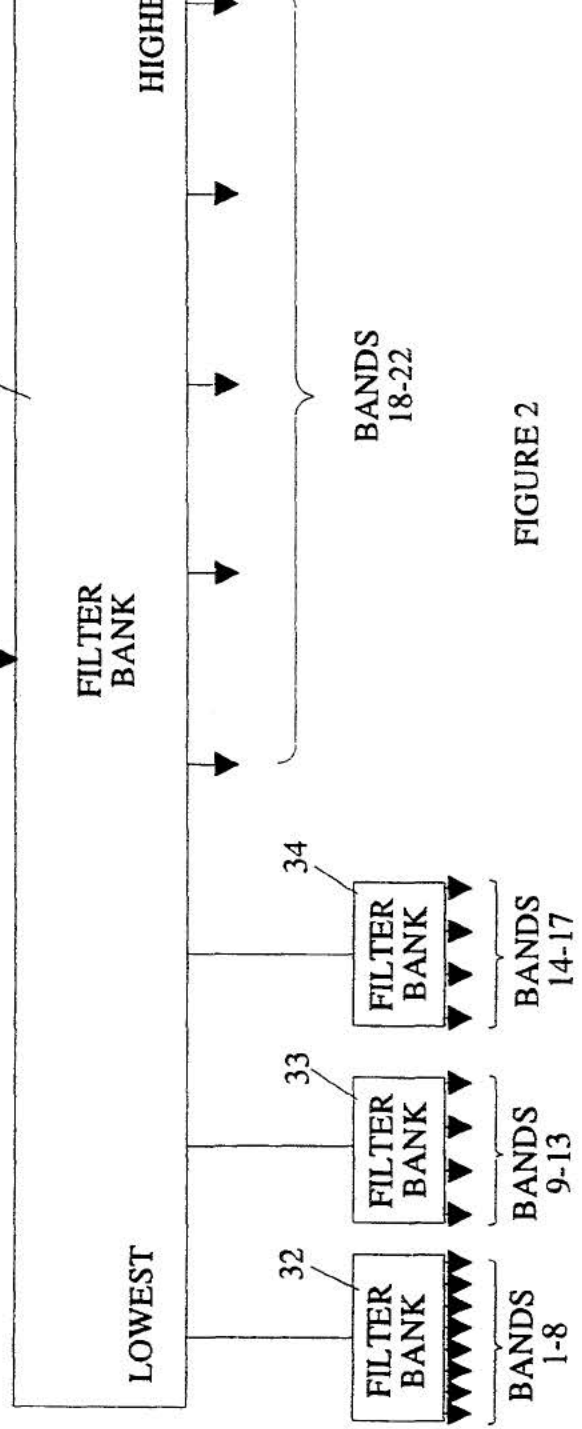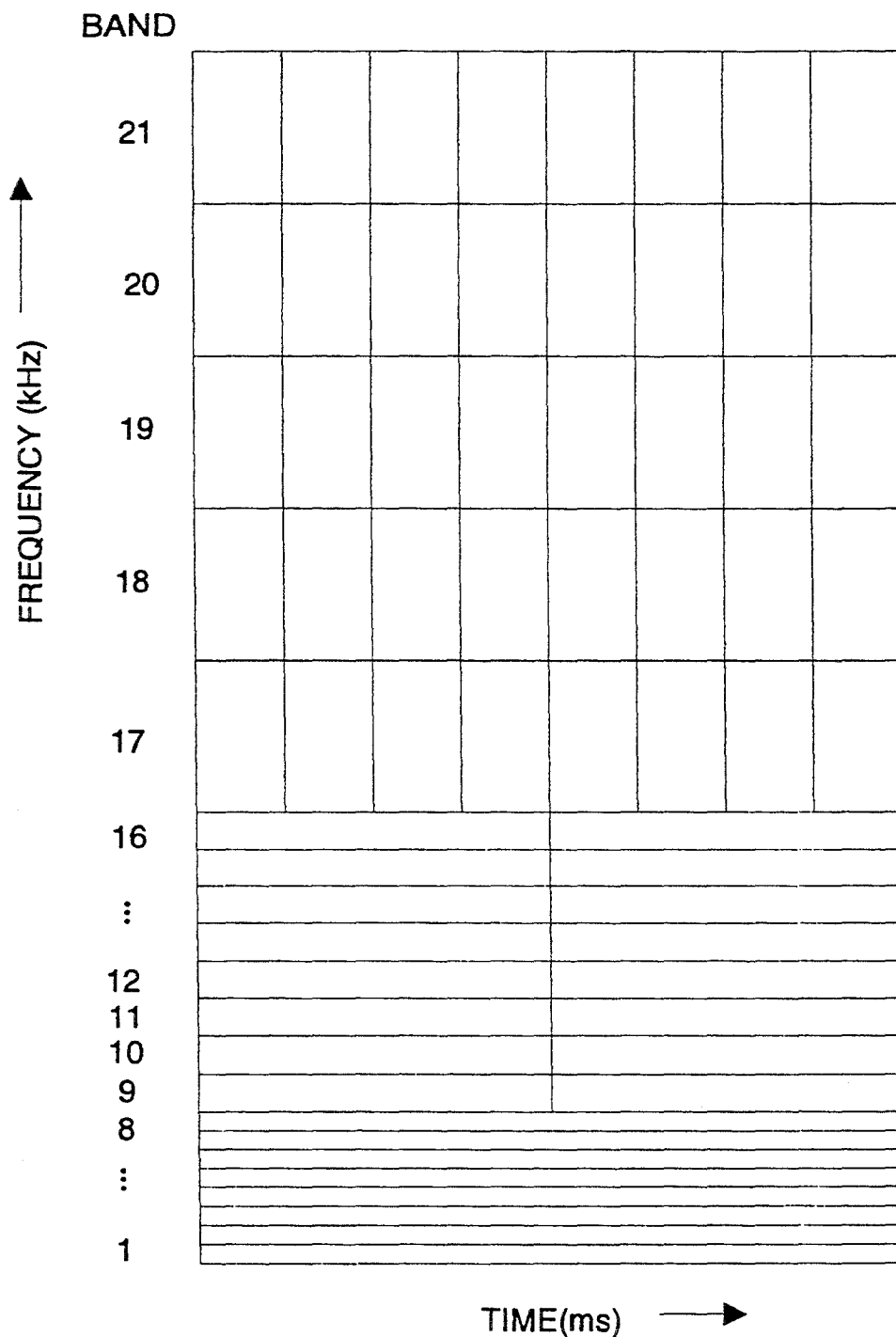
FIGURE 5(b)

DOCKET ALARM
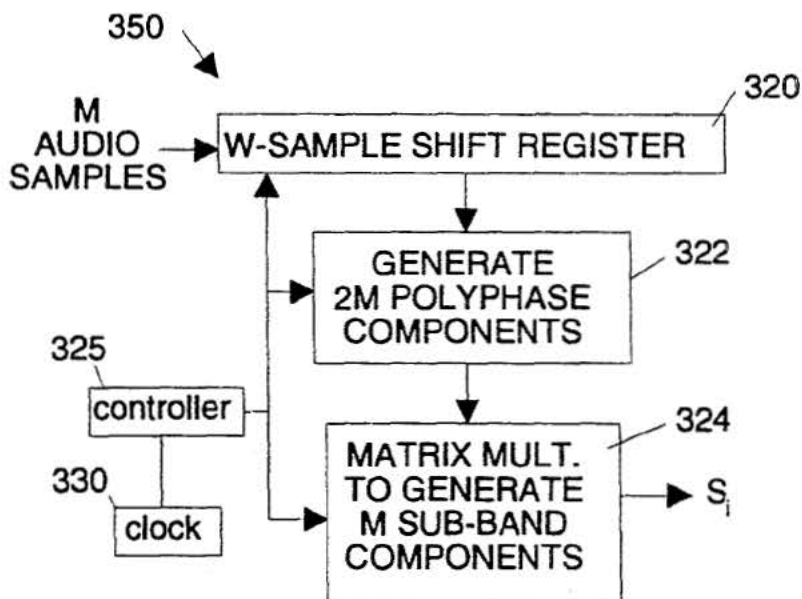
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