Pitch Detection and Intonation Correction Apparatus and Method

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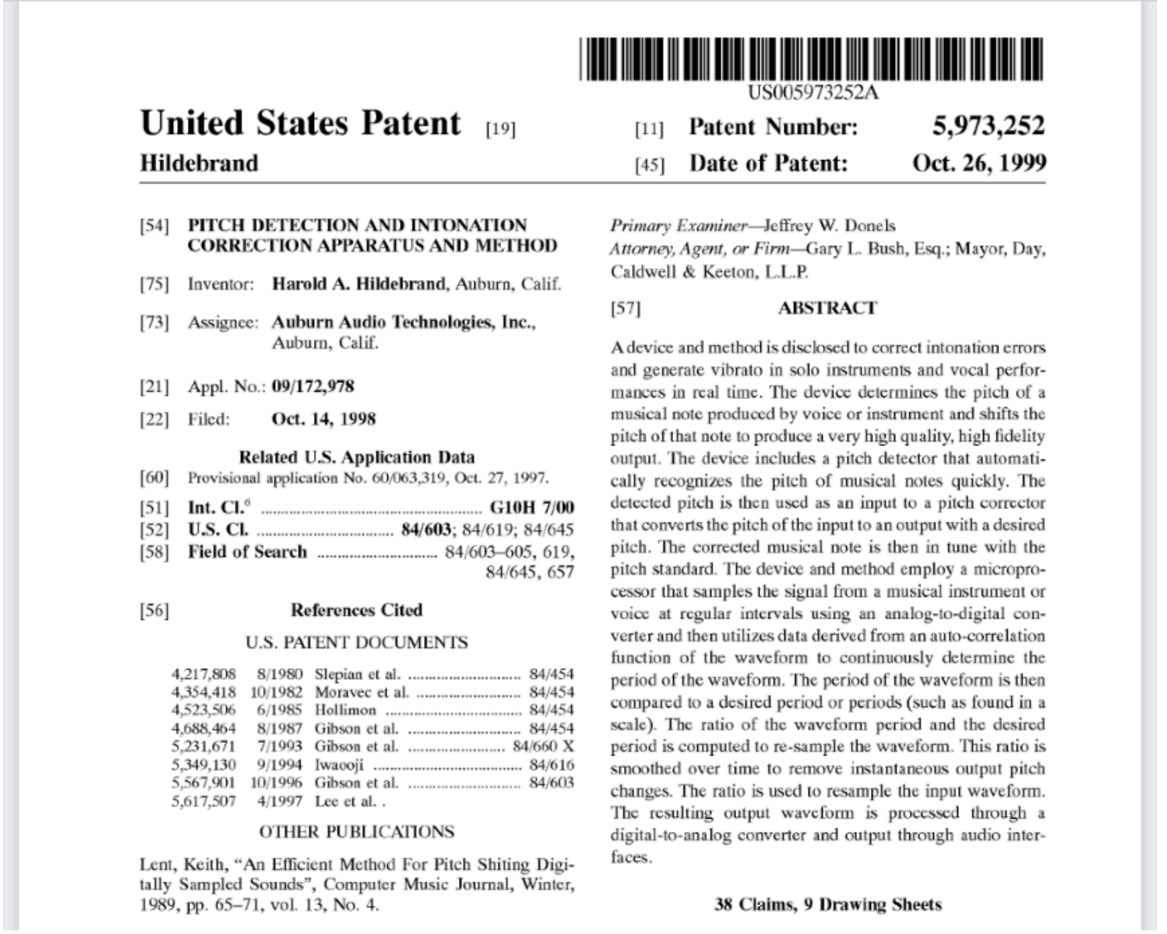

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[54] **PITCH DETECTION AND INTONATION CORRECTION APPARATUS AND METHOD**

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[52] **U.S. Cl.** **84/603**; 84/619; 84/645
[58] **Field of Search** 84/603–605, 619, 84/645, 657

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,217,808	8/1980	Slepian et al.	84/454
4,354,418	10/1982	Moravec et al.	84/454
4,523,506	6/1985	Hollimon	84/454
4,688,464	8/1987	Gibson et al.	84/454
5,231,671	7/1993	Gibson et al.	84/660 X
5,349,130	9/1994	Iwaooji	84/616
5,567,901	10/1996	Gibson et al.	84/603
5,617,507	4/1997	Lee et al. .	

OTHER PUBLICATIONS

Lent, Keith, "An Efficient Method For Pitch Shiting Digitally Sampled Sounds", Computer Music Journal, Winter, 1989, pp. 65–71, vol. 13, No. 4.

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[57] **ABSTRACT**

A device and method is disclosed to correct intonation errors and generate vibrato in solo instruments and vocal performances in real time. The device determines the pitch of a musical note produced by voice or instrument and shifts the pitch of that note to produce a very high quality, high fidelity output. The device includes a pitch detector that automatically recognizes the pitch of musical notes quickly. The detected pitch is then used as an input to a pitch corrector that converts the pitch of the input to an output with a desired pitch. The corrected musical note is then in tune with the pitch standard. The device and method employ a microprocessor that samples the signal from a musical instrument or voice at regular intervals using an analog-to-digital converter and then utilizes data derived from an auto-correlation function of the waveform to continuously determine the period of the waveform. The period of the waveform is then compared to a desired period or periods (such as found in a scale). The ratio of the waveform period and the desired period is computed to re-sample the waveform. This ratio is smoothed over time to remove instantaneous output pitch changes. The ratio is used to resample the input waveform. The resulting output waveform is processed through a digital-to-analog converter and output through audio interfaces.

38 Claims, 9 Drawing Sheets

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