United States Patent [19]

Trebino et al.

[11] **Patent Number:** **5,774,213**

[45] **Date of Patent:** **Jun. 30, 1998**

[54] **TECHNIQUES FOR MEASURING DIFFERENCE OF AN OPTICAL PROPERTY AT TWO WAVELENGTHS BY MODULATING TWO SOURCES TO HAVE OPPOSITE-PHASE COMPONENTS AT A COMMON FREQUENCY**

[76] Inventors: **Rick P. Trebino**, 425 Mulqueeney Dr., Livermore, Calif. 94550; **Nicholas M. Sampas**, 806 Fremont St., Menlo Park, Calif. 94025; **Eric K. Gustafson**, 835 Webster St., Apt. E, Palo Alto, Calif. 94301

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,601,182	6/1952	Tyler	356/321
3,332,313	7/1967	Batson	356/408
3,472,594	10/1969	Hughes et al.	356/320
3,647,299	3/1972	Lavallee	356/41
3,799,672	3/1974	Vurek	356/41
4,183,669	1/1980	Doyle	356/346
4,305,659	12/1981	Bilstad et al.	356/40
4,350,441	9/1982	Wicnienski	356/408 X
4,529,308	7/1985	Rife	356/323
4,948,248	8/1990	Lehman	356/41 X
5,028,787	7/1991	Rosenthal et al.	250/341
5,059,027	10/1991	Roesler et al.	356/346
5,137,023	8/1992	Mendelson et al.	128/633
5,184,193	2/1993	LeFebre	356/319
5,206,701	4/1993	Taylor et al.	356/325
5,245,406	9/1993	Masutani	356/346
5,251,008	10/1993	Masutani	356/346
5,349,952	9/1994	Carthy et al.	356/41 X

OTHER PUBLICATIONS

Kelleher, Joseph F., "Pulse Oximetry," Little, Brown and Co., 1989, pp. 37–62.

Primary Examiner—Vincent P. McGraw
Attorney, Agent, or Firm—Townsend and Townsend and Crew LLP

[57] **ABSTRACT**

A technique for making precise spectrophotometric measurements illuminates a sample with two or more modulated light sources at two or more, typically closely spaced, wavelengths. Light from the sources is combined, homogenized, and directed to the sample, and the light from the sample is collected and detected by a photodetector. The optical output powers of two sources are modulated with the same periodicity and with a reversed amplitude. Variations in the concentrations of species in the sample affect the modulation amplitude representing the sum of the optical powers from two sources in such a way as to produce an output signal. That output signal, based on an electrical component varying with a periodicity at the fundamental frequency, provides a measure of the difference in the transmissions (or other optical properties) of the sample at the two wavelengths. Feedback methods, such as null-point detection, provide stable, sensitive measurements. Wavelength-division multiplexing—required for simultaneous measurements at many wavelengths—is achieved by modulating different pairs of sources at different frequencies.

11 Claims, 11 Drawing Sheets

FIG. 1

FIG. 2a

Optical Powers from two Sources

ΔP_1

P_1

optical power of source 1

no light

ΔP_2

P_2

optical power of source 2

no light

time

Detected Optical Power

$\Delta P_1 - \Delta P_2$

$P_1 + P_2$

no light

time

FIG. 2b
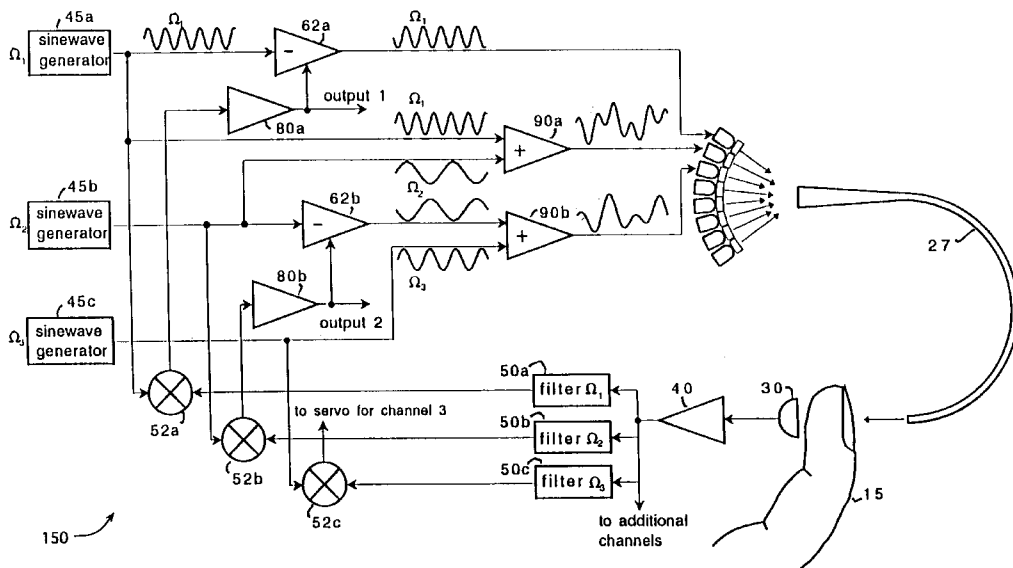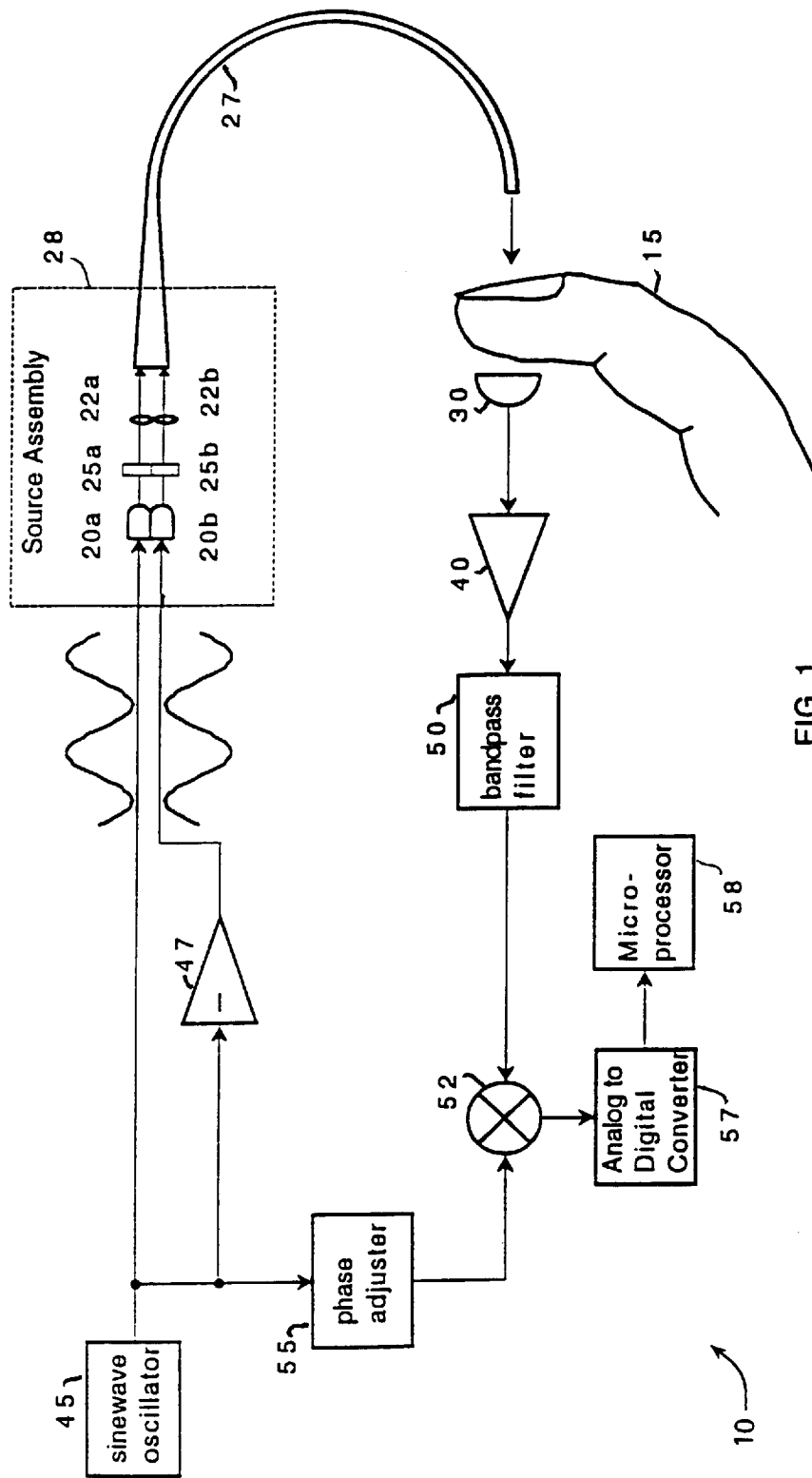
FIG. 3

DOCKET ALARM
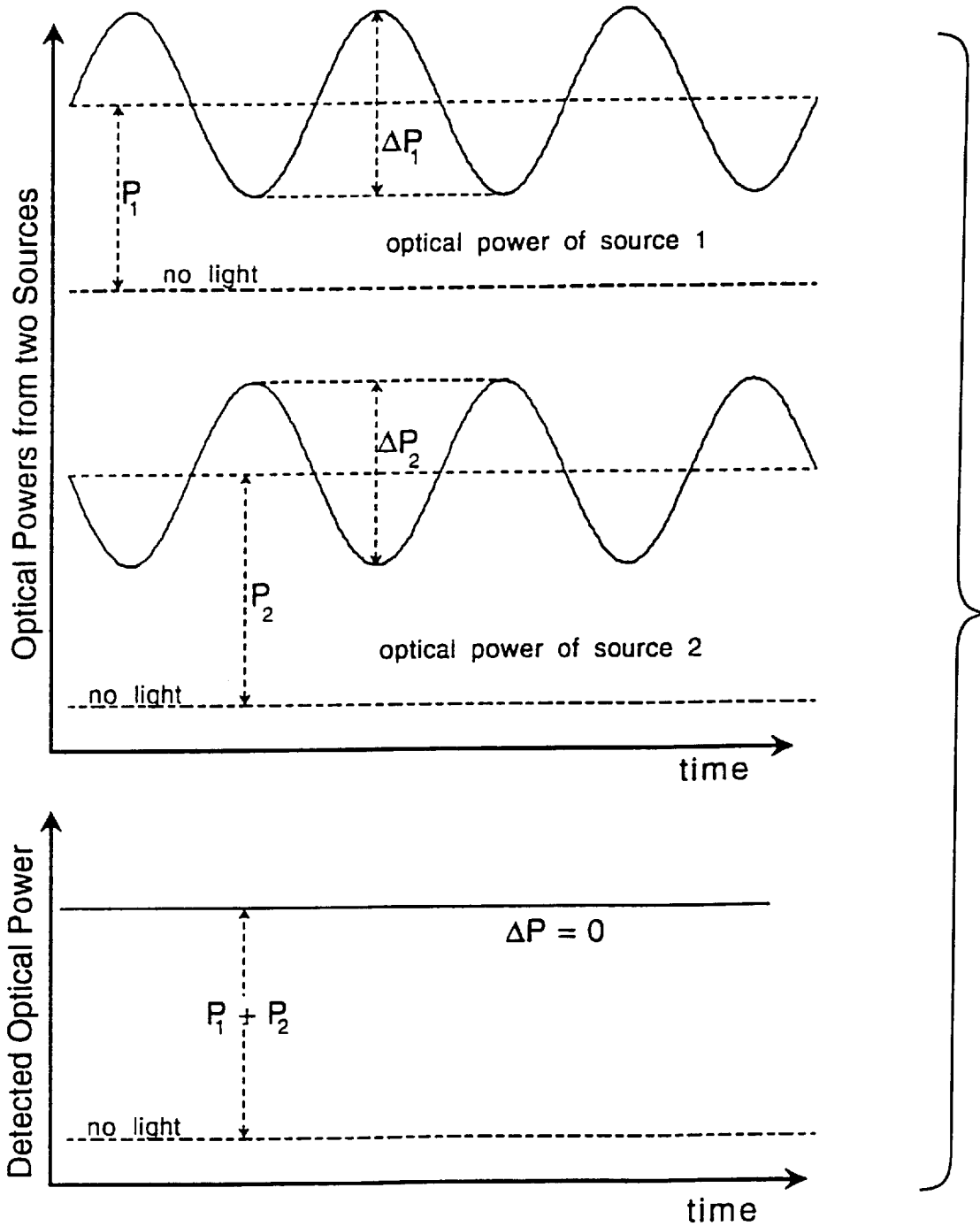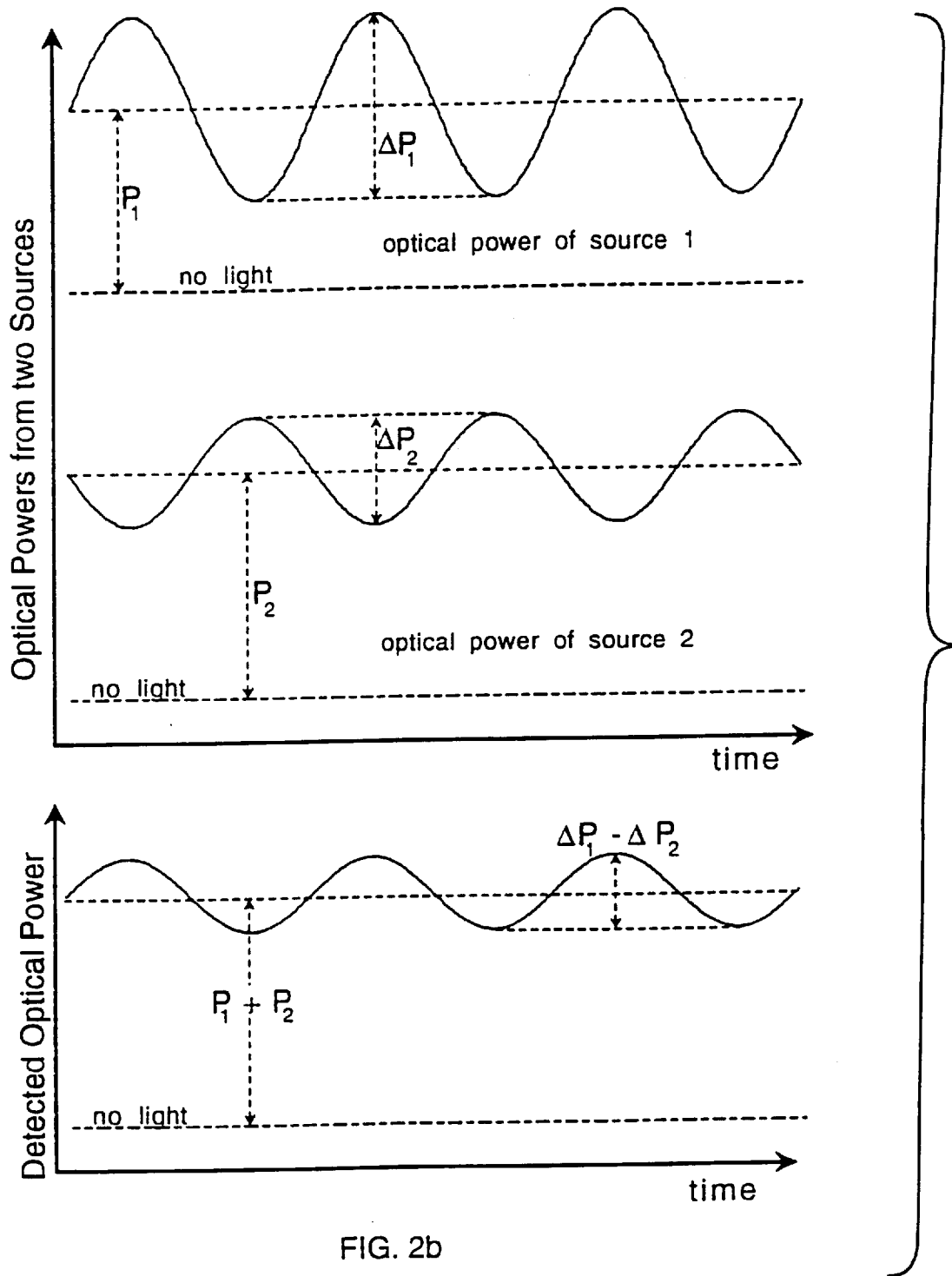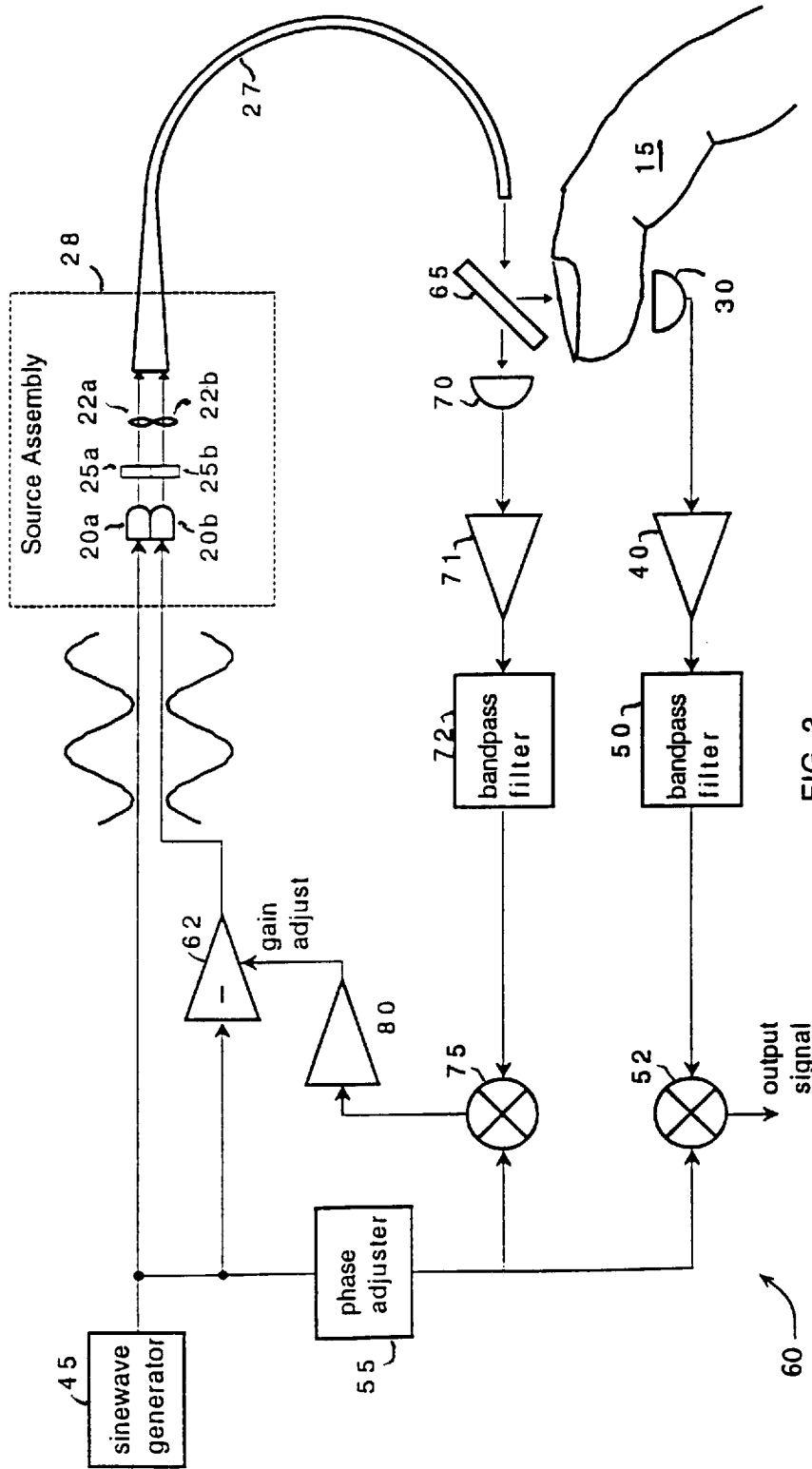
Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

fastcase®
Smarter legal research.