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Matsiev et al.

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(54) **MACHINE FLUID SENSOR AND METHOD**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,273,377	A		9/1966	Testerman et al.
3,329,004	A	*	7/1967	King, Jr. 73/24.06
3,622,968	A		11/1971	Silverman
3,710,275	A		1/1973	Tanaka et al.
3,718,032	A		2/1973	Gray
3,745,384	A	*	7/1973	Blanchard 310/324
3,762,197	A		10/1973	Roof et al.
3,778,757	A		12/1973	Houston

(Continued)

FOREIGN PATENT DOCUMENTS

DE	4424422	1/1996

(Continued)

OTHER PUBLICATIONS

Fisch, M.R., et al., "Improved Acoustic Viscosimeter Technique", J. Acoust. Soc. Am., Sep. 1976, pp. 623-625, v. 60, No. 3.

(Continued)

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(57) **ABSTRACT**

A method for analyzing a fluid contained within a machine, comprising the steps of providing a machine including a passage for containing a fluid; placing a sensor including a mechanical resonator in the passage; operating the resonator to have a portion thereof translate through the fluid; and monitoring the response of the resonator to the fluid in the passage. A preferred sensor includes a tuning fork resonator.

13 Claims, 5 Drawing Sheets