

United States Patent [19]**Huggins**[11] **Patent Number:** **4,513,404**[45] **Date of Patent:** **Apr. 23, 1985****[54] ACOUSTIC REFLECTOMETER FOR SHEET FEED SENSING****[75] Inventor:** **Raymond W. Huggins**, Pittsford, N.Y.**[73] Assignee:** **Xerox Corporation**, Stamford, Conn.**[21] Appl. No.:** **474,914****[22] Filed:** **Mar. 14, 1983****[51] Int. Cl.³** **G08B 21/00****[52] U.S. Cl.** **367/93; 271/259; 340/674****[58] Field of Search** **340/674; 367/93; 271/259, 258****[56] References Cited****U.S. PATENT DOCUMENTS**

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The present invention is concerned with a single sensor transmitter and receiver connected to a pneumatic bus. The pneumatic bus includes a plurality of sensor locations or ports disposed at various points along the paper path in a machine. The acoustic impedance characteris-

tic at each port is modified by the absence or close proximity of a sheet of paper. In a twin tube pneumatic bus version of the invention, there is a transmitting transducer connected to a transmitting tube and a receiving transducer connected to a receiving tube. Communication between the transmitting and receiving tubes is made through the oppositely disposed orifices or ports disposed along the paper path. Each of the transmitting and receiving tubes includes associated, oppositely disposed orifices, each pair of oppositely disposed orifices providing a port for determining the presence or absence of a sheet of paper. With no paper at a particular port, the transmitted signal is conveyed from the transmitter tube through the orifices to the receiver tube and back to the receiver. With paper in the path, between one or more of the pairs of orifices, the signal received by the receiving transducer is modified. In another embodiment, a single tube is used having one transducer connected to one end of the tube serving as both transmitter and receiver. Paper is detected by a change in the acoustic impedance of the tube orifice when paper is absent or in close proximity to the port. This impedance change results in a modification of the reflection of the signal from the port. One method of determining which of the orifices experiences the impedance change, or which pair of orifices is shielded is by pulsing the transmitting transducer, and time resolving the received signal.

11 Claims, 9 Drawing Figures