Detection of Interrupted Bubble Flow in the Technicon Automated Immunoprecipitin System

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A simple unit is described for detecting interrupted flow in an automated immunoprecipitin system. The principle involved is conductivity change resulting from interruption of bubble flow.

In an automated immunoprecipitin system for analysis of serum immunoglobulins (Technicon Instruments Corp., Tarrytown, N.Y. 10591) (1, 2) sampler lines of small inside diameter (0.0075 and 0.020 inch) must be used, and so flow is occasionally interrupted when the line becomes blocked by particulate matter. Cleaning the blocked line is simple; however, flow interruption is detected only by carefully observing the sampler probe line for lack of bubble flow when the probe switches between samples. Thus continuous operator attention is required; otherwise time and costly antiserum are lost before blockage is detected.

This note describes a simple system that promptly warns the operator that the sampler probe line is blocked. Because the sampler probe picks up a new sample every 1.2 min (50, 1/1 cam), an air bubble flows through the sampler probe every 0.6 min. With the present accessory, the passage of each bubble is used as a signal to trigger a retriggeable monostable multivibrator with a delay time greater than the bubble separation time. During normal operation the bubble pattern continues to trigger the monostable multivibrator and no change of logic state will appear at its output terminal. Should the flow pattern stop for any reason, after 1.4 min a "Sonalert" alarm will sound.

The detection system (Figures 1 and 2) consists of two 1.5-cm lengths of 0.010-inch (i.d.) stainless-steel tubing separated by a short (1.5 cm) piece of 0.010-inch (i.d.) sampler tubing that serves both as a connector and an insulator. All connections are slip-on and are immobilized so the tubing cannot flex. No distortion or interruption of flow has been found with this type of connection after 500 h of use. Electrical connections are silver-soldered to the stainless-steel tubes. A signal from a 1,000-Hz oscillator is applied to one of the stainless-steel tubes; the other tube is connected to the input terminal of an amplifier. The alternating signal source prevents polarization of the stainless-steel electrodes. When a bubble goes through the tubing between the two electrodes, a change in the amplitude of the 1,000-Hz signal is detected at the amplifier output. Full-wave rectification of the output produces a change in dc voltage level, which triggers the monostable multivibrator. The latter in turn controls a transistor (2N3417) that serves as a driver for an audible signal (Sonalert) and two relays (normally closed and normally open) that are available for stopping the turntable at a malfunction or for triggering any other equipment.

Fig. 1. Block diagram for line clog detector

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Fig. 2. Schematic for line clog detector

Resistors 15kΩ, 7.5kΩ, 1.5 MΩ, 2 MΩ, 10kΩ, 1kΩ, and 39kΩ are 0.25 W, 5% tolerance from Allen-Bradley Co., Milwaukee, Wis. 53204; resistor, "Trimpot," 1 MΩ, 0.5 W, 10% tolerance, Beckman Instruments, Fullerton, Calif. 92634; resistor, composition 3.3kΩ, 0.25 W and 330Ω, 0.5 W, 10% tolerance, Allen-Bradley; capacitor, ceramic, 0.02 μF and 0.01 μF, 25 V, 10% tolerance, Sprague Electric Co., North Adams, Mass. 01247; capacitor, electrolytic, 180 μF, 15 V, 10% tolerance, Sprague; integrated circuit amplifier μA 741 (U6A7741393) and μA 740 (U587740393), dual inline plastic package, Fairchild Semiconductor Corp., Mountain View, Calif. 94040; integrated circuit, logic (9601 re-triggerable one-shot 1.4-min delay) μL 9601 (U9A960159X), dual inline plastic package, Fairchild; transistor, silicon, NPN, 2N3417, General Electric, Schenectady, N. Y. 12305; diode, germanium, 1N5000, General Instrument; diode, Zener, 1N749, 4.3 V, 400 mW, International Rectifier; diode, silicon 1N914, General Electric; diode, Zener, 1N751, 5.1 V, 400 mW, International Rectifier; relay, mercury wetted, AR-05-451, 5 V, close ~500-Ω coil, SPDT, MKC Electric; power supply, regulated, LZD-22, ±15 V at 90 mA, Lambda Electronics Corp., Melville, L.I., N.Y. 11746.

During the 6 months the detector has been in use in our laboratory, it has been extremely reliable, with no malfunctions or required repairs. There has been a significant decrease in downtime for the system, which had been as much as 15 to 20%. Savings in time and antiserum consumption are substantial, because normally a clogged line is detected only when the absence of an antigen-antigody peak is indicated by the recorder, 16 min after sample pickup. The detector is small (20 X 12 X 12 cm) and easy to use, because it has only two switches (power on/off, and detector alarm on/off).

References