The emf impressed across the electromagnet was made available throughout the frequency range 10 to 100 cy/sec by using a 6SJ7 tube in a phase-shift oscillator circuit (Fig. 2). An almost pure sine-wave output with good frequency stability is obtained. The amplitude is controlled by potentiometer R_8. Adjustment of R_1 gives variable frequency operation; R_2 provides fine control for locating the exact resonance frequency of the blade. The electronic circuit is fed from a constant voltage transformer and incorporates a voltage regulator stage V_2.

To operate the apparatus, the oscillator is tuned to the resonance frequency of the blade, and adjustments are made so that the vibrator tip cuts through the liquid that accumulates just above the needle tip. The amplitude of vibration is adjusted until two streams of drops are thrown off, one on each side of the needle tip. A light focused on one of the streams renders it visible. Any splash caused by liquid feeding back along the vibrating blade tip and being thrown off must be shielded out to avoid interference with the drop stream.

The size of the drops emitted depends chiefly on the rate of flow of the liquid. The frequency of the vibrator and the amplitude of the vibrating tip govern drop size to a lesser extent. To determine drop size, the frequency of generation was determined by means of a stroboscope, and the drops formed over a period of time were weighed. The mass per drop was calculated and converted to volume per drop through a density factor. Work so far has been confined mainly to oil solutions. The stains resulting from the contact of the drops with various surfaces may be made visible by dyeing the solution.

The action of the vibrator in producing drops may be seen by using a stroboscope. The blade tip emerges from the liquid, drawing a filament of the liquid after it. The filament then detaches itself from the main body of the liquid and follows in the wake of the blade, becoming spherical in shape and moving outward and downward from the needle tip.

The apparatus was developed primarily for use in insect toxicology, particularly for the topical application of drops of insecticidal solution to insects. However, it has since been found useful in other ways, for example (i) to deliver precisely measured small amounts of liquids, and (ii) as a calibration tool in insecticide spray work. Dye tracers in airplane spray experiments produce visible stain patterns on sampling surfaces. Determination of the exact relationship between stain size and drop size adds greatly to the precision of spray deposit assessments.

References and Notes

* Contribution No. 151 Forest Biology Division, Science Service, Department of Agriculture, Ottawa, Canada. Suffield Technical Paper No. 22, Defence Research Board, Department of National Defence.

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2. B. Vonnegut and R. Neubauer, General Electric Research Laboratory Occasional Rept. No. 29, Project Cirrus, Rept. No. RL-555 (1951).
3. ———, *J. Colloid Sci.* **7**, 616 (1952).
4. J. M. Davis, *U.S. Dept. Agr. Bur. Entomol. Plant Quarantine*, No. ET-295 (1951).

5. The assistance of F. E. Owen, Entomology Section, and W. L. Clink, Physics and Meteorological Section, of the Defence Research Board, Suffield Experimental Station, is gratefully acknowledged.

6. List of circuit components: C_1, C_2, C_3, 0.001 μf mica capacitor; C_4, 0.5 μf paper, 600 v; C_5, 0.1 μf paper, 600 v; C_6, C_7, 16 μf electrolytic, 450 v; C_8, 32 μf electrolytic, 450 v; *SW*-SPST switch; *F*, fuse, 1 amp; *P*, pilot lamp, 110 v; V_1, 6SJ7 tube; V_2, V_3, 6V6-GT; V_4, 6X5-GT; V_5, OD3 VR-150; L_1, filter choke, Hammond No. 152; L_2, filter choke, Hammond No. 156; R_1, frequency control, 3-gang potentiometer, 10 megohm per section; R_2, frequency control, potentiometer, 0.5 megohm; R_3, R_4, R_5, 1 megohm 0.5 w; R_6, 0.47 megohm, 0.5 w; R_7, 2.2 megohm, 0.5 w; R_8, amplitude control, potentiometer, 1 megohm; R_9, 15,000 ohm, 10 w; R_{10}, R_{11}, 68,000 ohm, 1 w; T_1, power transformer, 310-0-310 v rms, 70 ma.

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Semiautomatic Device for Washing Tissues

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The semiautomatic wash rack to be described was developed (*1*) in this laboratory to facilitate the handling of tissue specimens that require prolonged washing after fixation. The apparatus stops fixation and initiates washing at any desired hour of the day.

The rack (Fig. 1) is constructed of two sheets of 14-gage stainless steel, 15½ by 5½ in. after flanging, *A* and *B*, the upper sheet *A* being perforated with 16 holes of 1⅛-in. diameter. The holes are spaced 2 in. apart from center to center lengthwise and 3¼ in. apart from center to center across. The sheets are 2½ in. apart, and they are held in position by upright pieces of stainless steel, *C* 6 by ¾ by ⅛ in., which are silver soldered at the center line of the ends of the sheets.

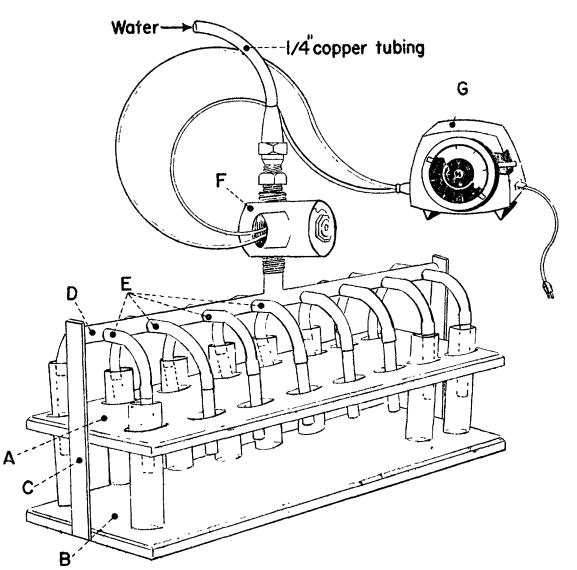

Fig. 1. Apparatus for semiautomatic wash rack.

The upright straps also serve to support a standard ¼ in. brass pipe *D* into both sides of which, at intervals of 1¾ in. center to center, a ¾-in. length of ¼-in. stainless-steel tubing *E* is silver soldered.

An electrically controlled valve *F* (*2*) is connected to the water-supply line and mounted at the center of the standard ¼-in. brass pipe. It is recommended that a vacuum breaker be installed in the water-supply line to obviate any possibility of back syphonage.

The valve is connected to a "time clock" *G* (listed in most scientific catalogs) which is set to turn the water on at the end of the desired periods of fixation and to turn the water off when washing is completed.

For fixation, properly identified tissues are placed into Moss Embedding Bags (*3*) that are inserted into vials. The water outlet for each vial is fitted with rubber tubing, and a glass spout extends from the tubing into the vial.

The design of the wash rack may readily be modified to meet the needs of individual laboratories.

Notes

1. We wish to express appreciation to Edwin Herskind, Institute of Tuberculosis Research, who constructed the apparatus to our specifications.
2. Skinner Valve No. 5-6260, 115 v, 60 cycles.
3. A. S. Aloe Co., No. 64690.

26 March 1954.

Versatile Anaerobic Spectrophotometer Cell

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This paper describes an anaerobic cell that is similar to the Thunberg tube but permits the measurement of reaction rates in the Beckman Model DU Spectrophotometer. Strict anaerobiosis is obtained by bubbling oxygen-free N_2 or helium through the cell in a manner similar to that described by Singer and Kearney (*1*). The visible absorption spectrum can be measured under anaerobic conditions during or at the end of the reaction. Provision is also made whereby one component can be reduced by catalytic hydrogenation and then added to the body of the cell under anaerobic conditions.

The apparatus (*2*) is illustrated in Fig. 1. The total height of the body should be at least 11 cm in order to prevent protein solutions from foaming into the side arm during deoxygenation. The bubbling tube is fabricated in two parts to decrease its fragility, these parts are joined by a section of voltron plastic tubing. The lower part of the bubbling tube is bent to fit in one corner of the body, out of the way of the optical path (see Fig. 1, right); it almost reaches the bottom of the body.

Anaerobic addition from the side arm. The main body, side arm, and bubbling tube (Fig. 1, left) are used. One component necessary for the initiation of the reaction is placed in the side arm either by injecting it through stopcock *A* by means of a hypodermic

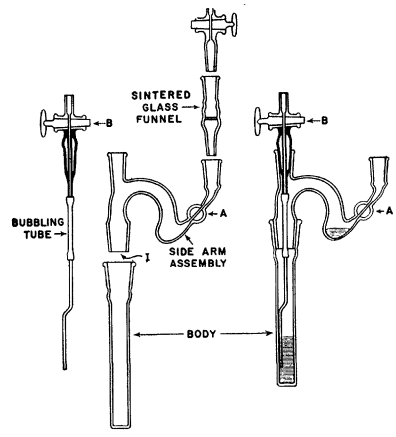

Fig. 1. Component parts of anaerobic Beckman cell.

needle or by inverting the side-arm assembly and carefully pipetting it through opening *I*. The other components are placed in the body. The joints are lubricated and the apparatus is assembled as shown in Fig. 1, right. Oxygen-free nitrogen or helium, prepared by passing the gas through heated copper screens, is bubbled through the cell. After 10 min, stopcock *A*, and then stopcock *B*, are closed, and the cell is transferred to the spectrophotometer.

Owing to the height of the assembly, it is necessary to build a light-tight box that fits over the spectrophotometer cell compartment mounting block, carriage, and phototube compartment. After a zero reading is taken, the contents of the side arm are tipped into the body and the reaction is started. Readings are taken in the usual way. It is possible to run two anaerobic cells simultaneously by placing them in positions 1

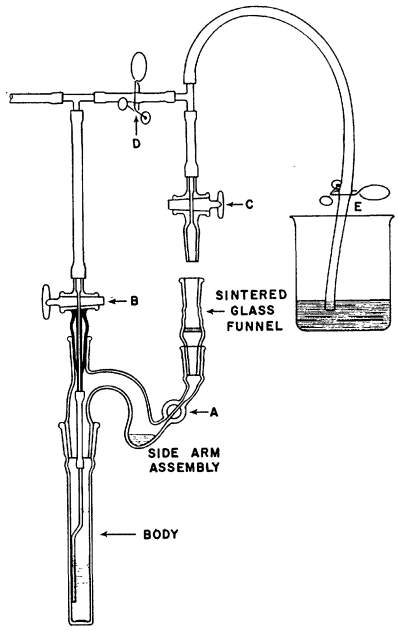

Fig. 2. Anaerobic Beckman cell assembled.