

A Two-Channel Electrical Counter^{1,2}

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Many studies require that the magnitude of 2 variables be determined simultaneously. Usually this is done by an operator using 2 hand-operated mechanical reciprocating counters. The operator records one variable on one counter and the second on the other. Our specific problem was to determine pollinator densities in field plots. The operators counted a fixed number of flowers and recorded the number of pollinators on these flowers.

A number of problems arise from the use of these devices. The reciprocating counters are hard to use, resulting in manual fatigue, and are infamous for missing counts, particularly when they become worn. The operator must have both hands full all the time he is making the count. If the operator must do something else with his hands, he must store the counters where they will not become lost or interchanged.

The 2-channel counting system described here overcomes these difficulties by using 2 electromechanical counters mounted in the same case. Pushbutton switches which have a low operating force (1.4 kg nominal) activate these counters. The battery, rather than the operator's thumb, supplies the power to drive the counters. The positive action of the switches and the sound of the counters operating decrease the chance of missed counts. The fixed physical relationship of the counters and unambiguous labeling prevent the counts of pollinators and plants from being interchanged. The simple arrangement of the counter system and decreased operating force speed counting and

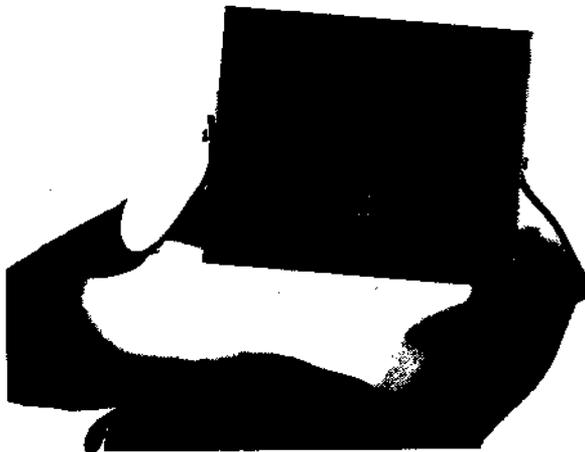


FIG. 1.—Two-channel electrical counter.

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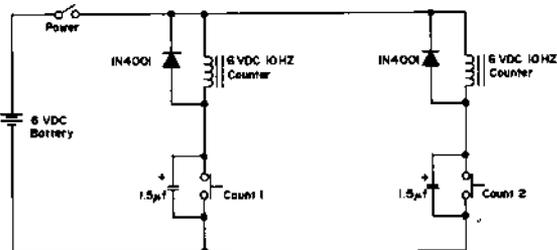


FIG. 2.—Electrical schematic for 2-channel counter.

allow more data to be collected than with mechanical counters. Each counter has a mechanical reset button to clear the counter after a count is completed.

Both counters, all the control switches, and the battery are installed in a 13×15×10-cm aluminum box (Fig. 1). The assembled weight of the unit, including the battery, is 1.3 kg. The 10-cm depth of the box is small enough that the operator can grasp the box with the fingers on the underside and the thumbs against the pushbutton switches. This allows the operator to press the pushbuttons positively with little muscular motion, reducing fatigue.

By adding a wide strap to suspend the counter unit around the operator's neck, it is possible to free both hands for other tasks as may be required. This arrangement positions the counter where it is always immediately at hand so no time is lost setting up for another count.

The electrical schematic, Fig. 2, of these counters is extremely simple and can be assembled by anyone familiar with good soldering technique. The power toggle switch protects the battery in case the counter has something pressed against one of the sensitive count switches in transit or storage which would drain the battery.

The parts cost per unit for these electrical counters is ca. \$60.00. Although this cannot compete in cost with 2 of the mechanical reciprocating counters which cost in the range of \$6.00 to \$8.00 each, decreased operator fatigue, elimination of the inherent ambiguity of 2 separate mechanical counters, and increased accuracy because of the positive action of the electromechanical counters outweigh the economic advantage of the mechanical reciprocating counters. The parts consist of 2 SODECO/TM Model TCeBZ4E 6 VDC 10 Hz electromechanical counters, 2 Micro Switch/TM Model 1PB42 pushbutton switches, 2 1N4004 diodes (or equivalent), 2 1.5 μF 200 VDC capacitors, 1 Eveready/TM 510S 6 VDC battery, and 1 SPST toggle switch.

In one summer's experience determining honey bee, *Apis mellifera* L., densities on onion, *Allium cepa* L., umbels grown for seed, there have been no reports of operator fatigue or confusion with these units. The response to the design of these counters by all operators has been very positive.

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