A MECHANICAL TRAP FOR THE SAMPLING OF AERIAL INSECT POPULATIONS[1]

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The essential principle involved in the construction of all models of this trap is that power is so applied to one or more rigid insect nets as to cause them to rotate in a fixed horizontal plane at a speed sufficient to capture and concentrate in a removable collecting bag any insects which might be intercepted.

A trap (fig. 1) built upon the plan here presented will efficiently sample aerial insect populations, with the possible exception of certain insects such as swiftly flying Odonata and Diptera. It offers a quantitative method of determining the population density of flying insects at different elevations and at different periods of the diurnal and annual cycles relative to such factors as time, temperature, humidity, and light intensity. Accurate records can be obtained for periods as brief as 5 minutes or less or for as much longer as desired. If the interval between the taking of collections is not too long, the insects caught are generally not seriously damaged and are for the most part in suitable condition for preservation as museum specimens.

This trap works efficiently and independently of the use of attractants or light. For certain insects, however, when maximum catches are desired rather than random samples of populations, lights, baits, or combinations of both can be effectively used as adjuncts.

An excellent illustration of the type of data which can be obtained with this machine is contained in a paper by Barnes, Fisher, and Kaloostian,[2] who used one of the machines built by the present writers.

[1] This is a revision of processed Circular ET-163 published by the Bureau of Entomology and Plant Quarantine in October 1940.

[2] Barnes, Dwight F., Fisher, Charles K., and Kaloostian, George H. Flight Habits of the Raisin Moth and Other Insects as Indicated by the Use of a Rotary Net. Jour. Econ. Ent. 32 (6): 859-863, illus. 1939.

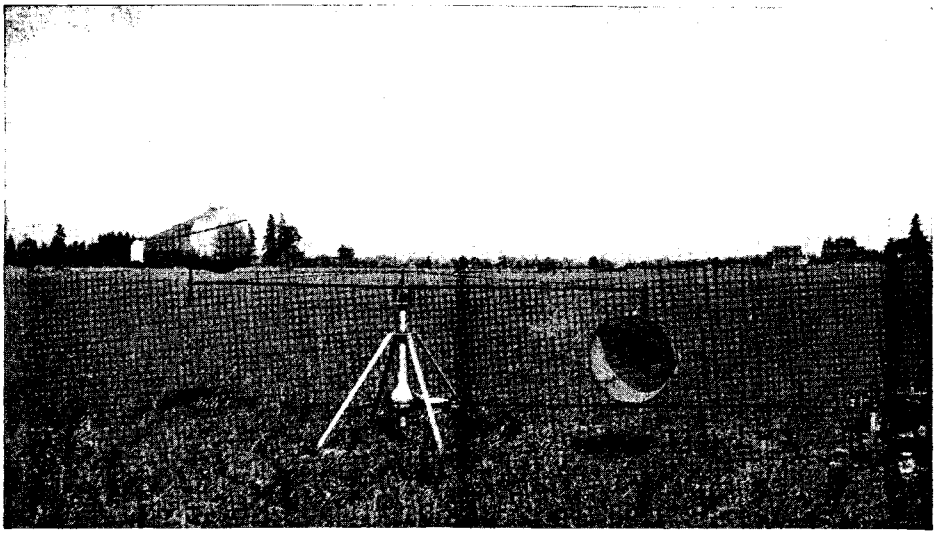

Fig. 1. General view of rotary trap. The entire net assembly may be supported either by a heavy bolted wooden construction or by a pyramidal frame of welded angle iron as shown.

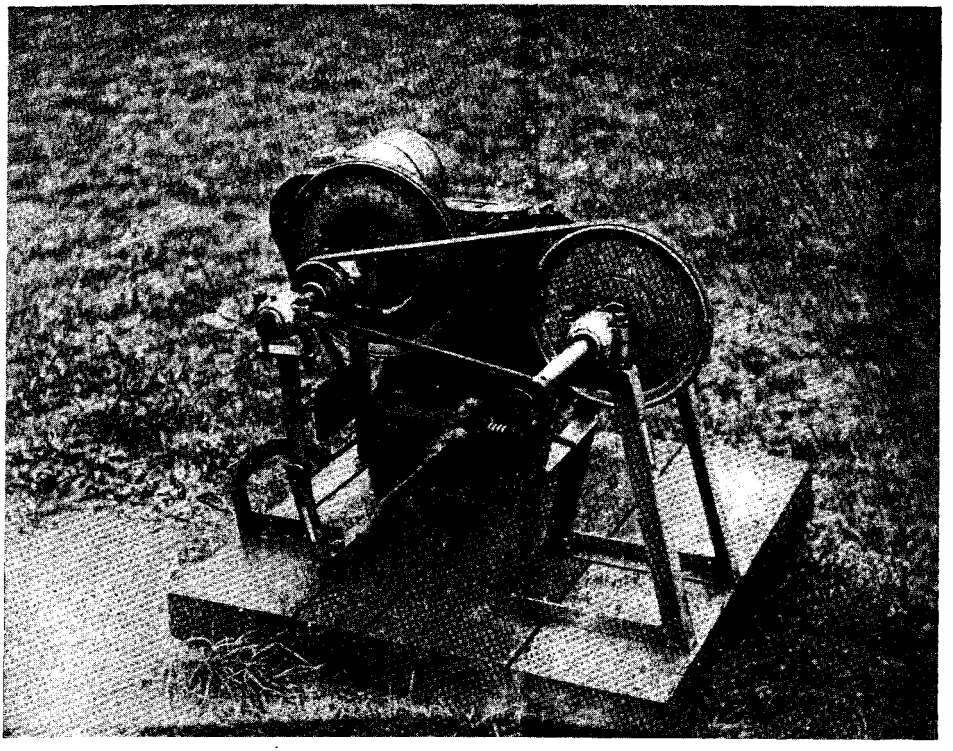

Fig. 2. Motor and clutch assembly. The trap is started or stopped by tightening the belt by means of the specially mounted automobile jack, which tilts the countershaft. The motor is a 1-horsepower, air-cooled gasoline engine.

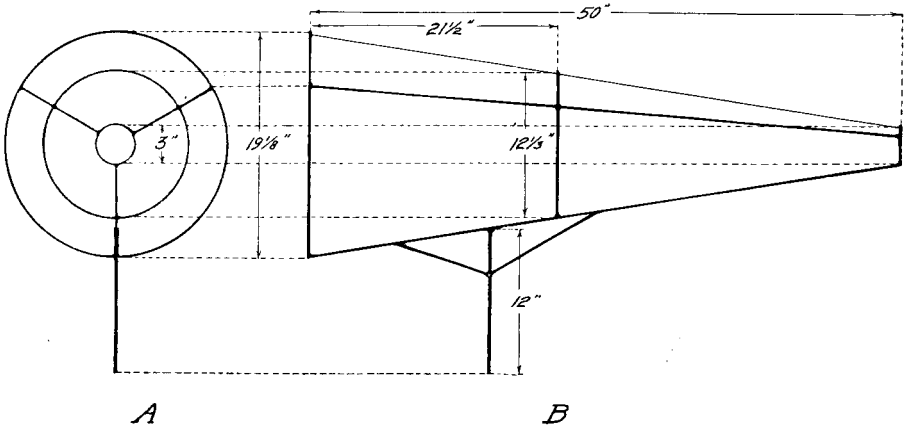

Fig. 3. Diagram showing the dimensions and construction of the collecting net. The framework is of ¼-inch iron rod and welded throughout, except for the 12-inch supporting arm, which is of ½-inch rod or pipe. *A*, Front view; *B*, side view. The net covering (not shown) is of 16-mesh screen wire with all seams soldered.

Each net of this trap (net opening, 2 square feet in area; diameter of circle described by net, 12 feet) will theoretically collect the insects from approximately 248,000 cubic feet of air per hour at a speed of 55 r. p. m.

The cost of the machine, exclusive of the motor, will range from $50 to $70 if built by hired labor. The machine can be built by any good automobile mechanic or machinist.

The net assembly comprises one or more nets, together with supporting radial arms and adjustments. Where only one net is employed, it must be suitably counterbalanced. Each net is mounted at the end of a braced, 6-foot arm, so that in rotation the nets describe a circle 12 feet in diameter.

Since the speed of the motor is much greater than that of the net, and the axis of rotation of the motor is in a horizontal plane while that of the nets is in a vertical plane, it is necessary that there be an intervening set of gears. In the trap illustrated, a cutdown rear axle of a model T Ford car, mounted L fashion on the net support, serves this purpose. Any automobile rear axle should be equally adaptable. One axle is cut off just beyond the differential housing, and a plate is then welded across the casing to make it oil-tight. The hub of one of the wheels of the rear axle assembly is then employed for mounting the net arms, while the universal transmission joint of the drive shaft serves the same purpose in the trap as in the original automobile. Because of the light load, a light crankcase motor oil replaces the usual heavy lubricant in the differential. The whole unit is very durable and weatherproof.

The machine is driven by a transmission shaft extending from the net drive shaft to the motor and clutch assembly, which

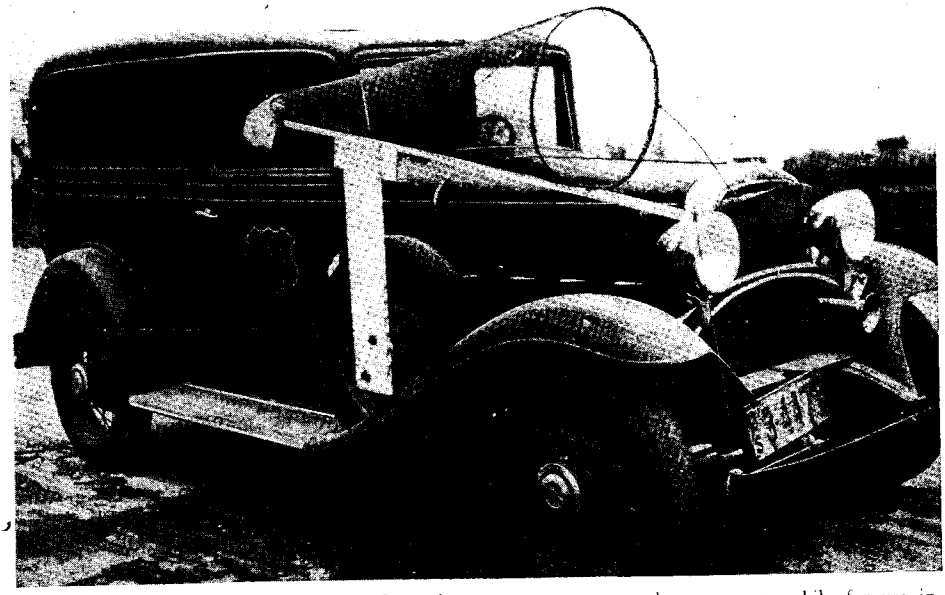

Fig. 5. Collecting net, of the type used on the rotary trap, mounted on an automobile for use in sampling aerial insect populations over extended areas.

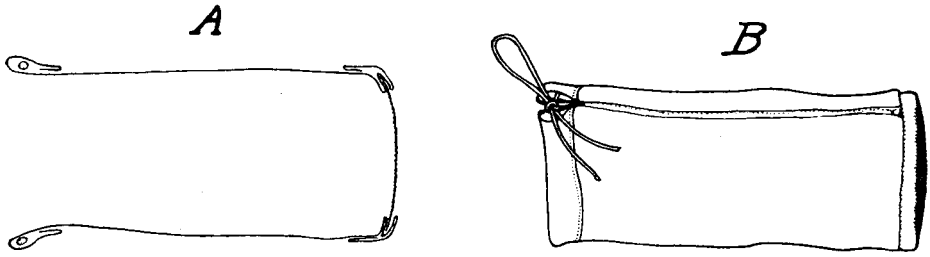

Fig. 4. Diagram showing construction of the collecting bag. The length is 7 inches, the diameter 3¼ inches. The material is muslin, with copper-gauze bottom. *A*, Diagrammatic cross section showing method of sewing in the drawstring and the screen bottom; *B*, the finished bag.

is mounted beyond the sweep of the rotating nets. A flexible connection should be used to connect the motor or drive shaft and the transmission shaft.

The motor and clutch assembly (fig. 2) comprises a small gasoline or electric motor. We have employed ½ to 1-horsepower gasoline motors and ¼ to ½-horsepower electric motors with complete satisfaction. Where electric power is available its use is preferable, since electric motors require less attention and are more reliable than gasoline motors. If a single-phase motor is employed, the use of a clutch is unnecessary, as the trap can be started and stopped by turning a switch. With split-phase motors the clutch must be used to avoid throwing too heavy a starting load on the motor. One net is about the maximum load for a ¼-horsepower motor. We have used a ⅓-horsepower motor to pull two nets. The power required depends somewhat upon the efficiency of the gears employed.

If the automobile transmission is used, one or more reduction pulleys or gears between the motor and clutch are necessary in order to achieve the required net speed. The exact nature and size of these reduction pulleys or gears will vary with the normal motor speed and the desired speed of rotation. Where belt transmission is used, slippage must be allowed for if a particular net speed is desired.

The details of the net construction are shown in figure 3. The framework of the net if of ¼-inch iron rod and is welded throughout. The net proper is of 16-mesh wire screen.

Two types of collecting bags have been used. One is shown in detail in figure 4. The fine copper-gauze bottom prevents serious injury or destruction of the trapped insects. If all-cloth (muslin or similar material) bags are employed, the use of a small wire frame to keep the bag permanently distended minimizes injury to the trapped insects. If such a frame is not used, strong eddies in combination with a marked whipping of the bag badly damage the insects caught.

At the end of each collecting period the small collecting bags are removed and immediately replaced by new bags. The insects collected in the small bags are killed by dropping the bag into a large-mouth killing jar and are later sorted and counted.

A net speed of 20 to 25 miles per hour is adequate to retain most insects. With 6-foot net arms, such as were used in the traps illustrated, a net speed of 55 r. p. m. is equivalent to 23 to 24 miles per hour.

If it is desirable to sample insect aerial populations over an extended area rather than in one spot, a net like the ones used on the rotary traps can be mounted on an automobile. When the car is in motion, insects are collected in exactly the same manner as by the rotary trap. Such a mount is shown in figure 5. It is important that the net be mounted at least 1 foot away from the fender or hood of the car to avoid strong eddies which tend to force insects through the mesh of the screen. The writers have used car speeds up to 45 miles per hour. This apparatus has proved useful under certain circumstances and can be built cheaply.