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AN AUTOMATIC DEVICE FOR DIVIDING AND PACKAGING LIGHT TRAP INSECT CATCHES ACCORDING TO TIME INTERVALS

Agricultural Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE

CONTENTS

AN AUTOMATIC DEVICE FOR DIVIDING AND PACKAGING LIGHT TRAP INSECT CATCHES ACCORDING TO TIME INTERVALS[1]

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INTRODUCTION

Although the number of insects attracted and caught at a light trap is determined both by the size of the insect population and by the amount of insect activity (6,13, 14),[3] activity is the controlling factor. A large insect population may go undetected because of no or low activity. The activity of insects is determined largely by physiological responses to cyclic factors in the environment. Light, temperature, humidity, and wind are but a few of the cyclic factors. These physiological responses must be determined if catch data from survey-type light traps are to be used successfully for predicting or measuring insect populations.

Some researchers have compared monthly insect catches with climatic changes (8). Some have compared night-to-night catches (4). A few have divided nightly catches into hourly periods (12). All of these studies have involved attempts at measuring the effects of the environmental factors on insect activity. Some general conclusions were reached and have been accepted. However, the specific influences of factors such as moonlight and wind velocity have not been definitely established. For example, what happens to insect activity when a cloud passes in front of the moon? At what wind velocity does insect activity cease? What effect does wind direction have? To answer these questions, insect catches for short time periods must be compared to specific environmental conditions, not to average conditions. This comparison requires that the insect catch be broken into minute intervals instead of hourly or nightly intervals, and the environmental conditions must be measured during each catch interval.

Considerable time and effort have been devoted by researchers to designing insect traps that separate the catch into discrete portions caught during different time intervals. One of the earliest devices, described by Seamans and Gray (10), consisted of seven separate traps programmed to be turned on and off individually at preset times throughout the night.

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2/ Agricultural engineers, ARS, USDA, College Station, Texas.

3/ Underscored numbers in parentheses refer to Literature Cited at the end of the report.

Williams (12, p. 2) invented a trap that had eight killing bottles arranged so that a clockwork mechanism changed the bottle under the trap at the desired time during the night. Hutchins (4) used a trap similar to the one used by Williams, but this trap had only six containers. Nagel and Granovsky (9, p. 2) also described a revolving jar-type trap.

Johnson (5) designed a trap in which the catch was deposited in a collecting tube. Closely fitting disks falling into this collection tube (one every hour) segregated the catch into successive hourly samples. Taylor (11, p. 2) modified Johnson's trap to improve the structural design and worked out construction details for larger traps. Harcourt and Cass (2) also built a trap using circular disks to divide the catch into portions representing periods of time. The moths were drawn by a fan into a collection cartridge where they were separated by the disks.

Bast (1) described a trap that used solenoids to close six compartments in a cylinder.

Horsfall (3) designed and built a disk-type trap similar to the one built by Taylor (11).

Another rotating jar-type trap was designed by Lafrance (7). The jars were rotated beneath the trap at the desired time intervals.

A trap that can divide a night's catch into shorter time intervals is needed so that more detailed research can be conducted on environmental effects on insect activity. The trap described in this report was designed, built, and tested for this purpose, and it is relatively simple, trouble free, and inexpensive.

DESIGN

Figures 1 and 2 show complete dimensions and details of the interval insect trap.

Lamp and Funnel

The trap was designed to accommodate most types of attractant lamps. In the prototype discussed in this report, a 15-watt F 12-BL (blacklight) fluorescent lamp was mounted between four 6-inch baffles. This assembly was mounted above a 15-inch funnel. If larger lamps, such as a 40-watt fluorescent, are used, the funnel size and other dimensions should be increased proportionally. (See details, fig. 1.)

Killing Chamber

The funnel is mounted on a 15 1/2-inch square base that fits over the killing chamber of the interval trap. A rain collector removes rainfall that comes down the funnel. The killing chamber (fig. 1) is 15 inches square at the top, 15 5/8 inches high, and 8 inches square at the bottom. Two additional walls in the chamber provide a compartment for holding cyanide crystals and reduce the bottom opening to approximately 3 x 8 inches.

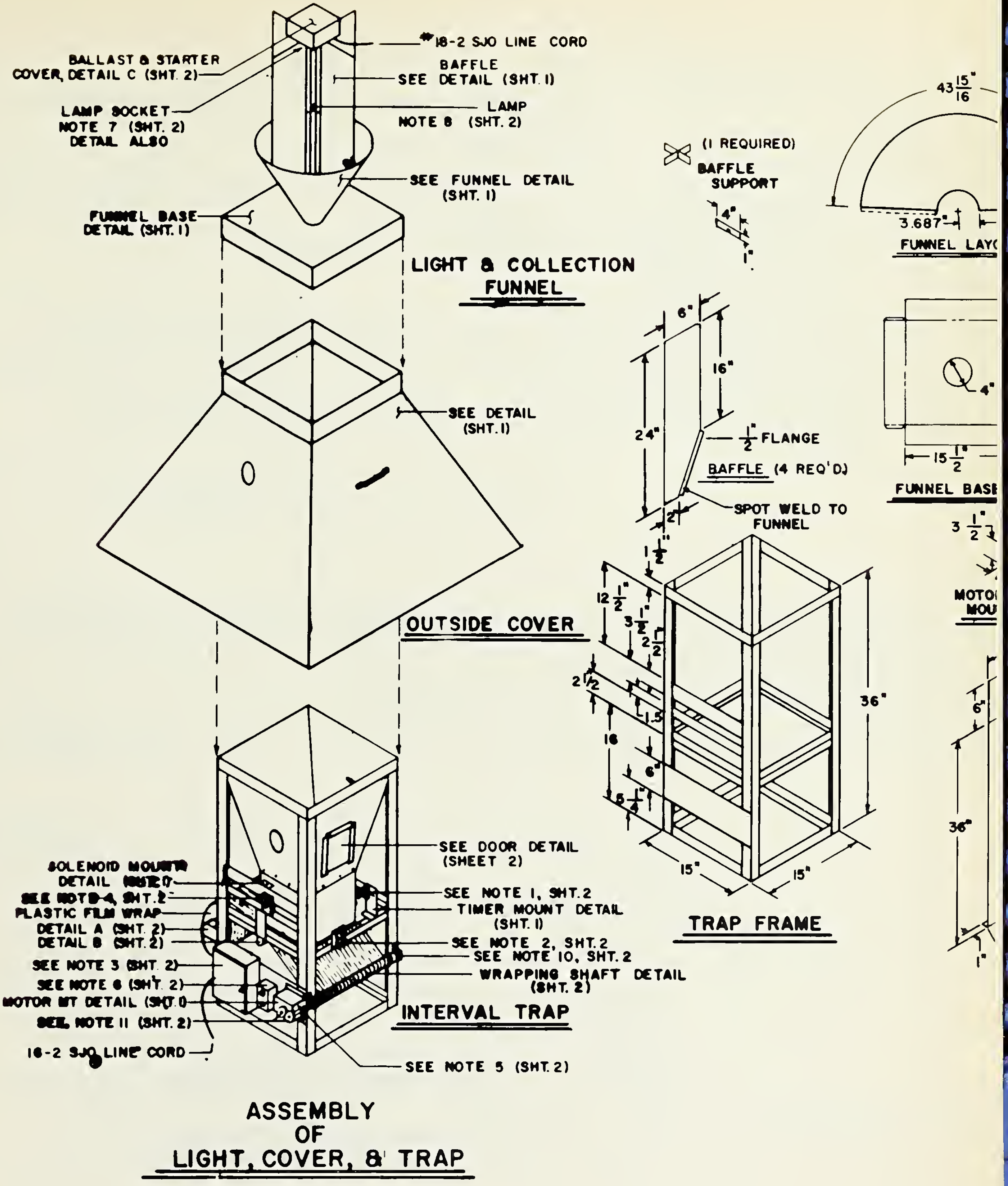
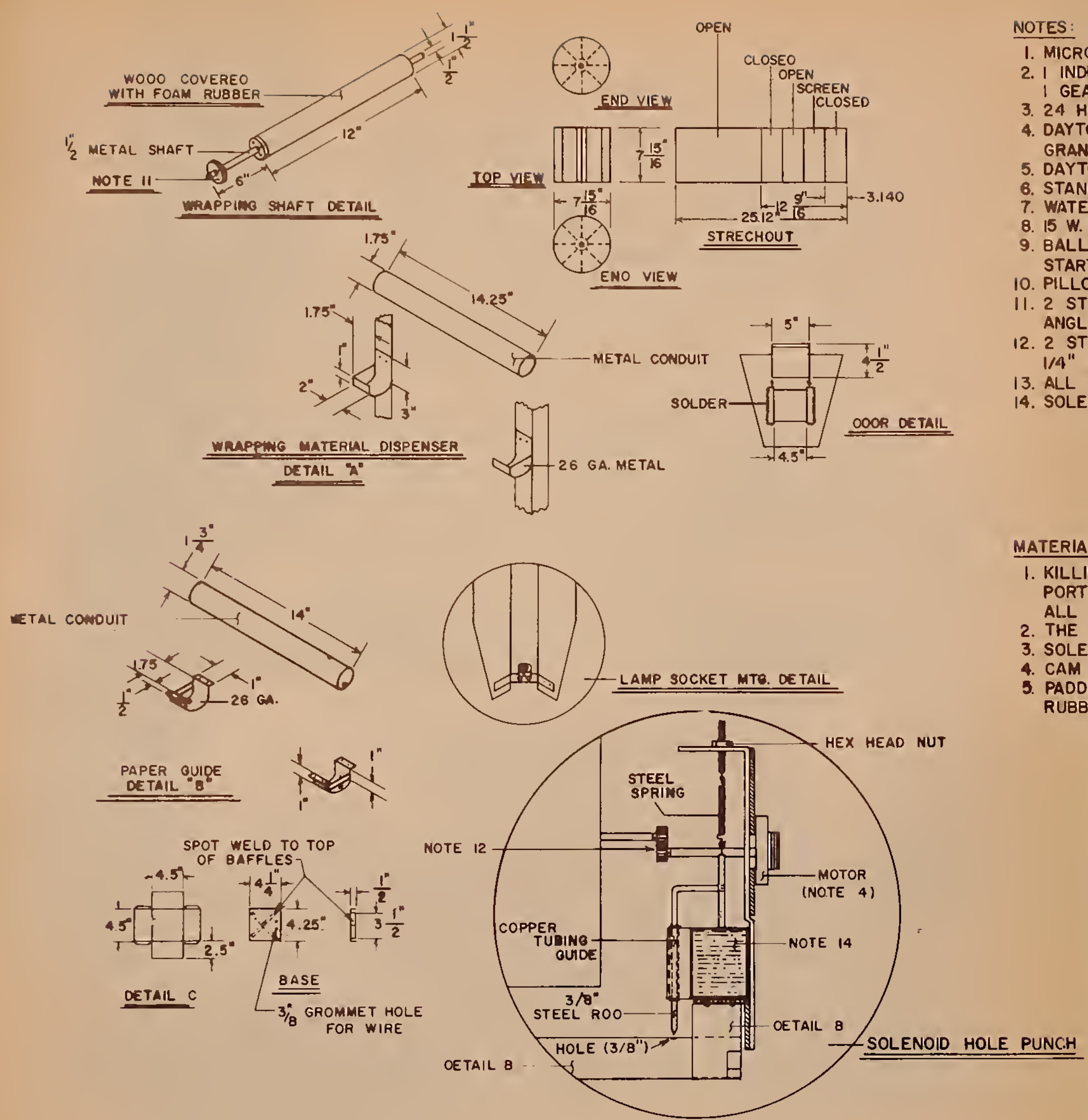


Figure 2.--Dimensions and



NOTES:

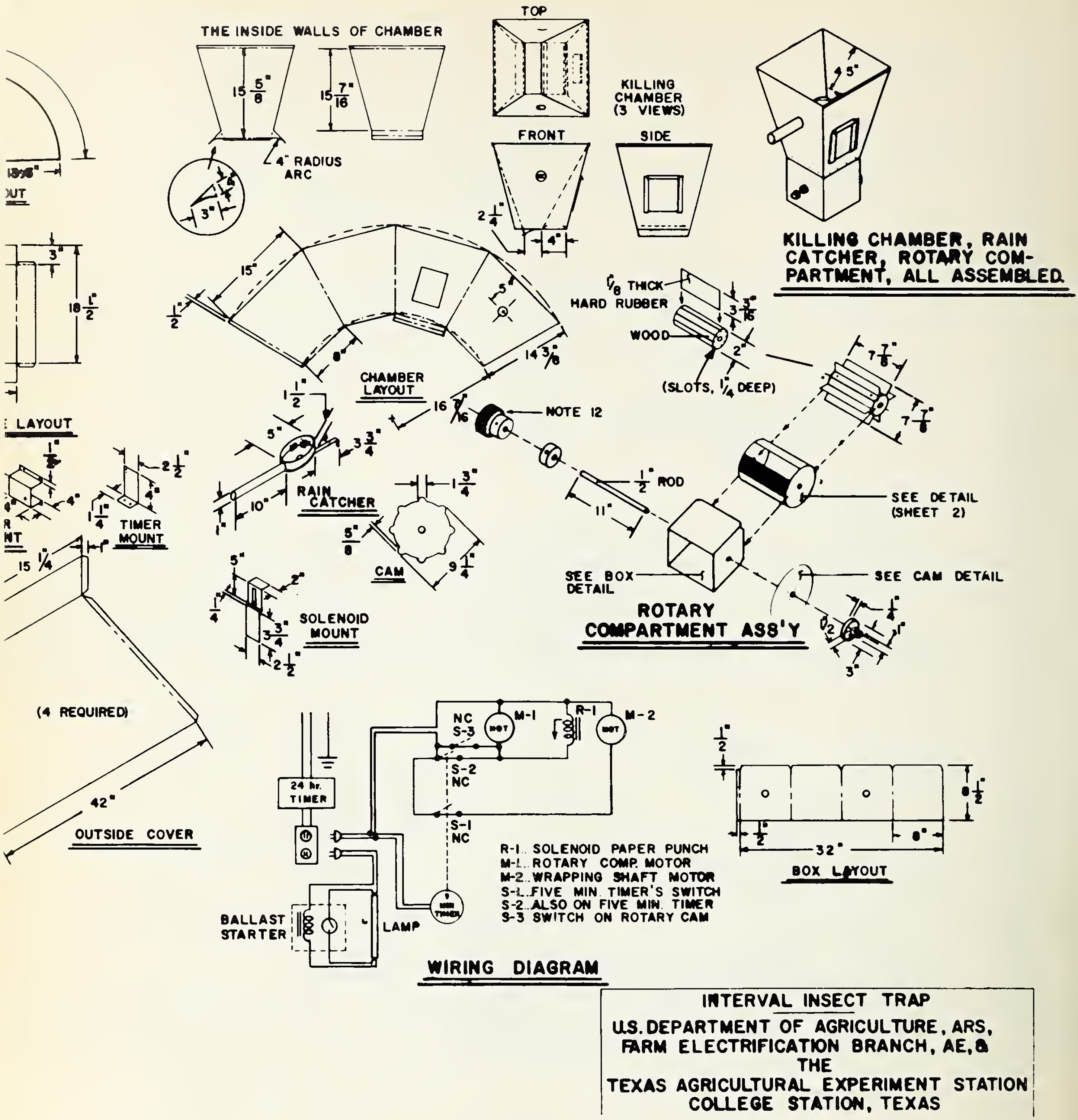
1. MICRO-TYPE BA-2RV2-A2, HEAVY DUTY SNAP ACTION SWITCH — SPDT.
2. 1 INDUSTRIAL TIMER CORP. TYPE MC-5 —2 CIRCUIT— SERIES FOUNDATION UNIT.
   1 GEAR & RACK —B-15— 5 MINUTE OVERALL TIME CYCLE. (OTHER TIMES FROM 2–18 MIN. CYCLES)
3. 24 HOUR TIMER.
4. DAYTON SHADED POLE GEAR MOTOR — 1 RPM — STARTING TORQUE 50 in-lbs. 1/250 hp.
   GRANGER CAT. NO. 3M095.
5. DAYTON SHADED POLE GEAR MOTOR —10 RPM— STARTING TORQUE 50 in-lbs. 1/40 hp. CAT. NO. 3M103.
6. STANDARD DUAL ELECTRICAL OUTLET.
7. WATERPROOF LAMPHOLDER G.E. 95 x 178 OR EQUIVALENT.
8. 15 W. BLACK LIGHT FLUORESCENT LAMP. G.E. F15T8/BL OR EQUIVALENT.
9. BALLAST — G.E. 89 G 381 OR EQUIVALENT.
   STARTER — G.E. FS-2 OR EQUIVALENT.
10. PILLOW BLOCKS — SPLIT CAST IRON — TYPE PPB
11. 2 STEEL SPUR GEARS — BOSTON GEAR TYPE - H2436, 36 TEETH, 24 PITCH, 14.5° PRESSURE ANGLE — 1/4" FACE. (USED FOR PAPER DRIVE)
12. 2 STEEL SPUR GEARS — BOSTON GEAR TYPE - H2420, 20 TEETH, 24 PITCH, 14.5° PRESSURE ANGLE 1/4" FACE. (USED FOR ROTARY DRIVE)
13. ALL SEAMS IN PARTS BUILT FROM SHEET METAL MUST BE SOLDERED FOR WATERPROOFING.
14. SOLENOID: 115 V. — 60 CYCLE A.C. COIL; DUTYCYCLE - CONTINUOUS.

MATERIAL:

1. KILLING CHAMBER, COLLECTION FUNNEL, FUNNEL BASE, OUTSIDE COVER, BAFFLES, BAFFLE SUPPORTS, BALLAST & STARTER COVER, ROTARY BOX, RAIN CATCHER, AND THE TIMER MOUNT ARE ALL MADE FROM 26 GA. GALV'D SHEET IRON.
2. THE FRAME IS MADE UP OF 1" ANGLE IRON & 1/8" THICK FLAT IRON.
3. SOLENOID & MOTOR MOUNTS MADE FROM 1/16" THICK FLAT IRON.
4. CAM IS CUT FROM 1/8" THICK ALUMINUM.
5. PADDLES IN ROTARY COMPARTMENT ARE TO BE MADE OF LIGHTWEIGHT, STURDY MATERIAL SUCH AS RUBBER MAT.

INTERVAL INSECT TRAP
U.S. DEPARTMENT OF AGRICULTURAL, ARS,
FARM ELECTRIFICATION BRANCH, AE, &
THE
TEXAS AGRICULTURAL EXPERIMENT STATION
COLLEGE STATION, TEXAS

Figure 1.--Dimensions and details of interval trap--sheet 1.



l details of interval trap--sheet 2.

Rotary Holding Compartments

Eight rubber paddles are mounted on a 2-inch-diameter shaft that is 7 15/16 inches long. This paddle wheel rotates in an 8-inch-diameter cylinder which has openings in the top and bottom to permit insects to be collected and deposited at the proper time. The other portions of this cylinder are made of screen wire and sheet metal. The paddle wheel and cylinder form holding compartments for the insects. The paddle wheel is fastened to a $\frac{1}{2}$-inch shaft geared to a 1-r.p.m. gear motor. The paddle wheel also operates a cam that operates the microswitch that controls the rotary motion of the holding compartments. At the preselected time, a new compartment is moved under the killing chamber to receive the insects caught.

Wrapping Section

Plastic film wrap 4/ is dispensed from a roll mounted on one side of the trap frame beneath the paddle wheel and is rolled up by a roller mounted on the opposite side. As the wrap unwinds, it travels over a guide and then slopes downward to the winding roll, which is powered by a 10-r.p.m. motor. A solenoid-driven punch marks the film for each time arrival. The packaging section is enclosed by a metal cover to protect it from wind and rain.

Electronic and Timing Controls

A 24-hour timer controls the complete trap. A 5-minute-interval timer, equipped with two microswitches and a synchronous motor, controls the collection intervals. Interval timers are available in a wide range of timing intervals.

PRINCIPLE OF OPERATION

Path of Insects

The path of travel for the insects is shown in figure 3. Insects attracted to the blacklight lamp enter the killing chamber through the funnel located beneath the lamp, where vapor from the cyanide crystals knocks them down within a few seconds. The insects fall into the paddle wheel compartment at the bottom of the killing chamber. At the end of the time interval--5 minutes in this particular design--the paddle wheel turns one-eighth of a revolution, placing a new compartment under the killing chamber. After four time cycles, the insects have traveled to the bottom of the paddle wheel cylinder where they fall out onto the plastic film. They slide down the film into the groove formed by the film and the winding roll. A few seconds later, they are rolled up in the plastic film by the winding roll. They remain here until the plastic film is unrolled for insect counts and identifications.

4/ Scott plastic wrap, 12 inches by 500 feet.

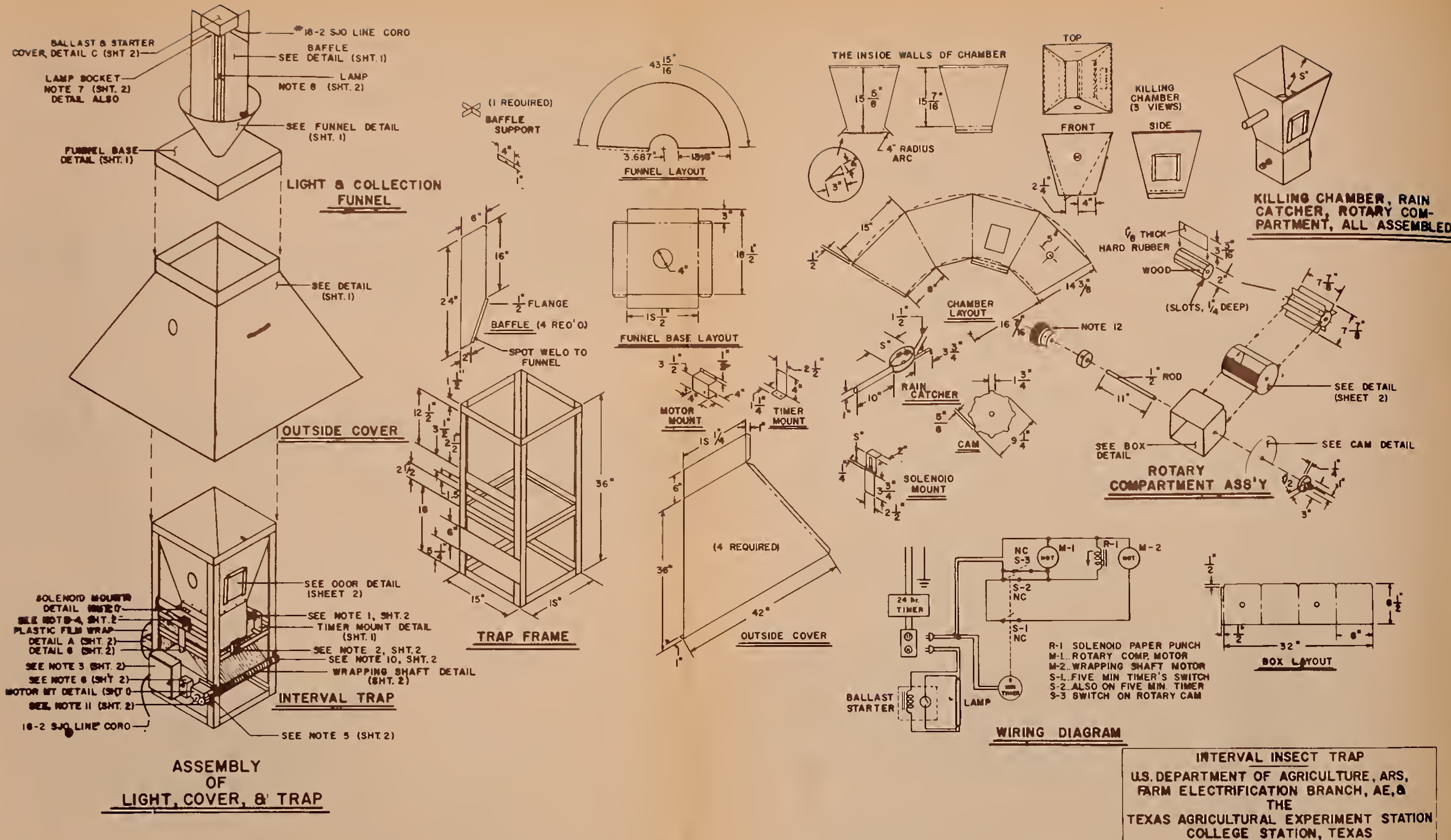


Figure 2.--Dimensions and details of interval trap--sheet 2.

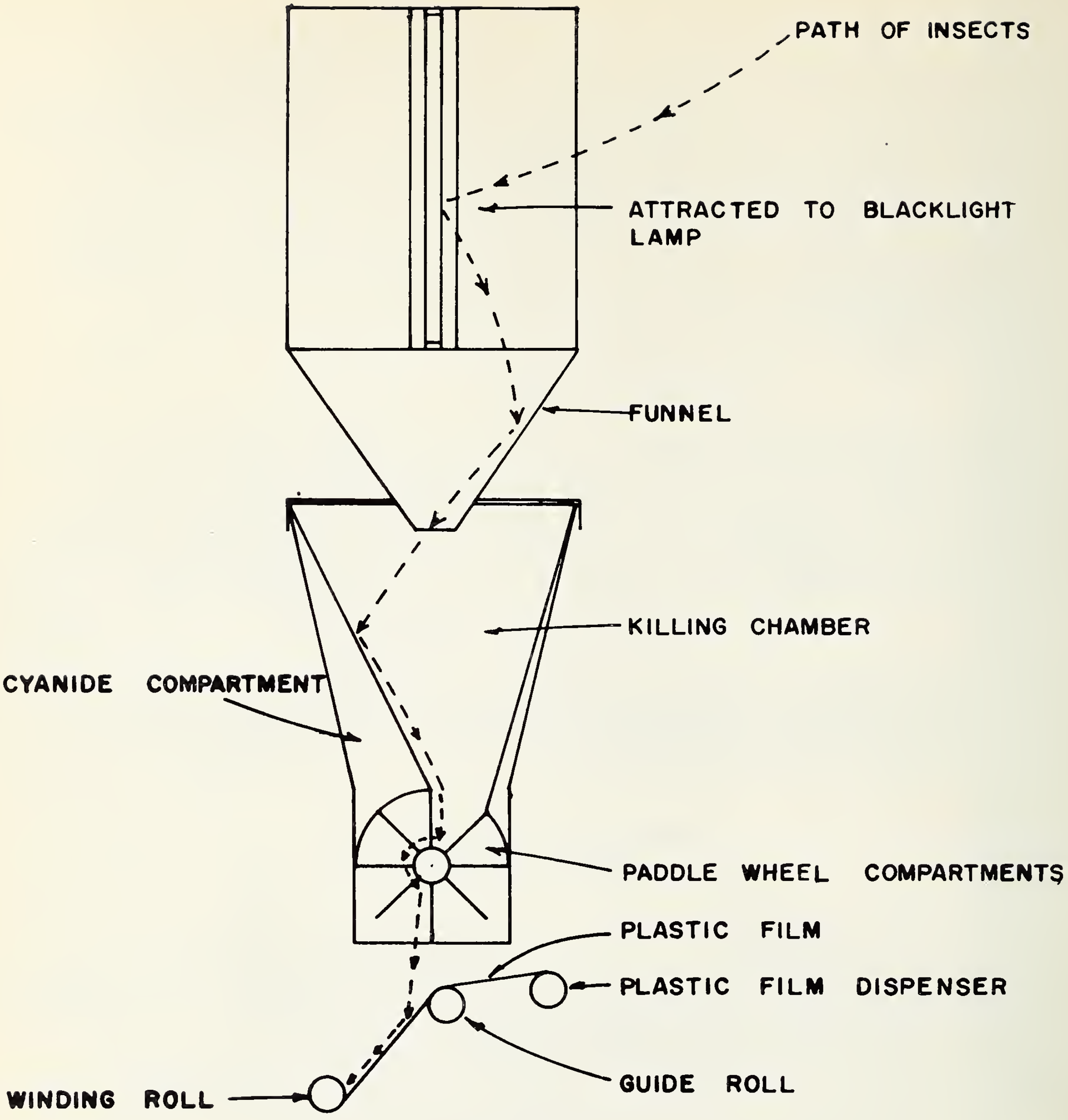


Figure 3.--Interval trap showing insect path.

Electronic Controls

The 24-hour timer turns the trap on at the desired time. At the end of the first time cycle, the 5-minute timer cam closes the microswitch, S-2, (fig. 1). This switch starts the rotary compartment motor, M-1. As soon as the paddle wheel has moved one-half inch, the rotary compartment microswitch, S-3, closes and takes over control of M-1. S-2 opens again after S-3 takes over. The next projection on the cam fastened to the rotary compartment shaft opens S-3, stopping M-1 and positioning the next compartment under the killing chamber. After a few seconds the 5-minute timer cam closes S-1, and starts the wrapping shaft motor, M-2. The timer permits this motor to turn the wrapping shaft approximately one revolution. The paper solenoid punch, R-1, is connected in parallel with M-1 and punches a hole in the plastic film when this motor is turned on. After 5 minutes the above cycle is repeated.

Insect Killing

Granular cyanide (American Cyanamid Type "G") is placed in paper bags and hung from the four top corners of the killing chamber. Bags containing cyanide are also placed in the compartment formed by the paddle wheel cylinder and the false sides of the killing chamber. The paddle wheel cylinder is made of screen wire which permits the fumigant to reach the insects.

Insect Identification

The complete trap can be cut off by the 24-hour timer if the shutoff time can be determined within 1 to 2 minutes. This cutoff is necessary to permit the operator to correlate the 5-minute-interval insect groups with the actual time they were caught when he unrolls the plastic film. The wrapping shaft can be removed from the trap by cutting the film and removing the top half of the two pillar blocks.

Limitations

1. Hard-to-kill insects, such as large beetles, may not fall into or out of the compartments at the right time.

2. The 500 feet of plastic film will, under normal conditions, last only 8 or 9 nights.

3. Any time interval can be had with the proper timer motor; however, many insects are difficult to kill in less than 1 minute. On the other hand, a long time interval might be undesirable if large numbers of insects were present since the wrapping shaft might become overloaded and possibly crush the insects or fail to wind them all up as a group.

RESULTS

A prototype of the trap described was constructed and operated during the summer of 1967 at the Texas A&M University plantation. No mechanical failures occurred and only minor adjustments were necessary. Figure 4 shows the trap completely assembled. Figure 5 shows the trap with the metal cover removed.

Figure 4.--Interval trap completely assembled for field operation.

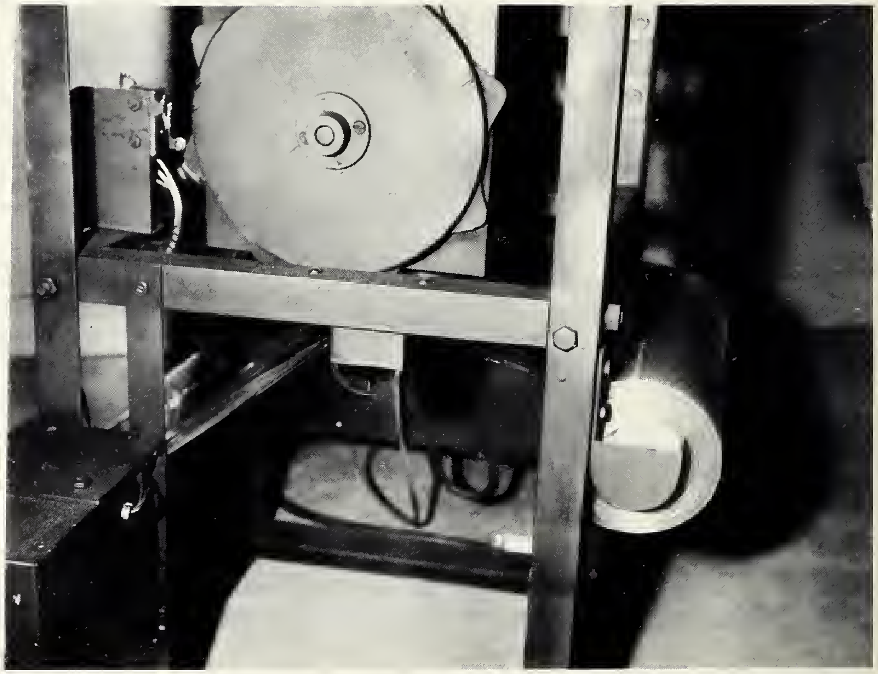


Figure 5.--Interval trap with outside cover removed to show plastic film and packaging section.

Figure 6 shows typical 5-minute-interval catches. The fact that the insects are in good condition and the time intervals are well defined permits easy identification of insects and time of flight.

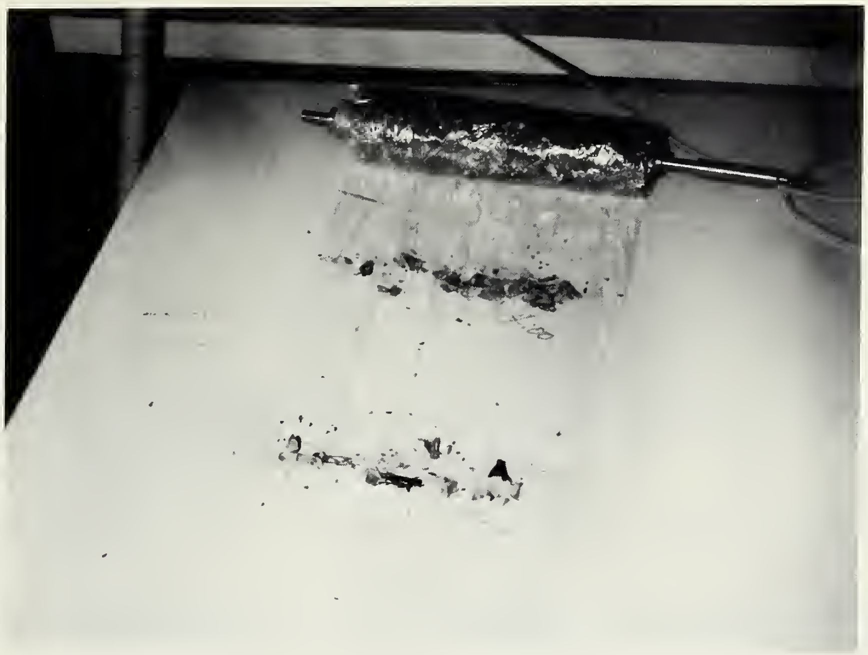


Figure 6.--Insect package being unrolled after typical night's catch. Two 5-minute interval catches are shown.

Figures 7 and 8 show graphs of a typical night's catch of cabbage loopers (Trichoplusia ni (Hubner)) and bollworms (Heliothis zea (Boddie)). The hourly curve is smooth, whereas the 5-minute curve varies sharply as a result of environmental factors or random activity.

ACKNOWLEDGMENTS

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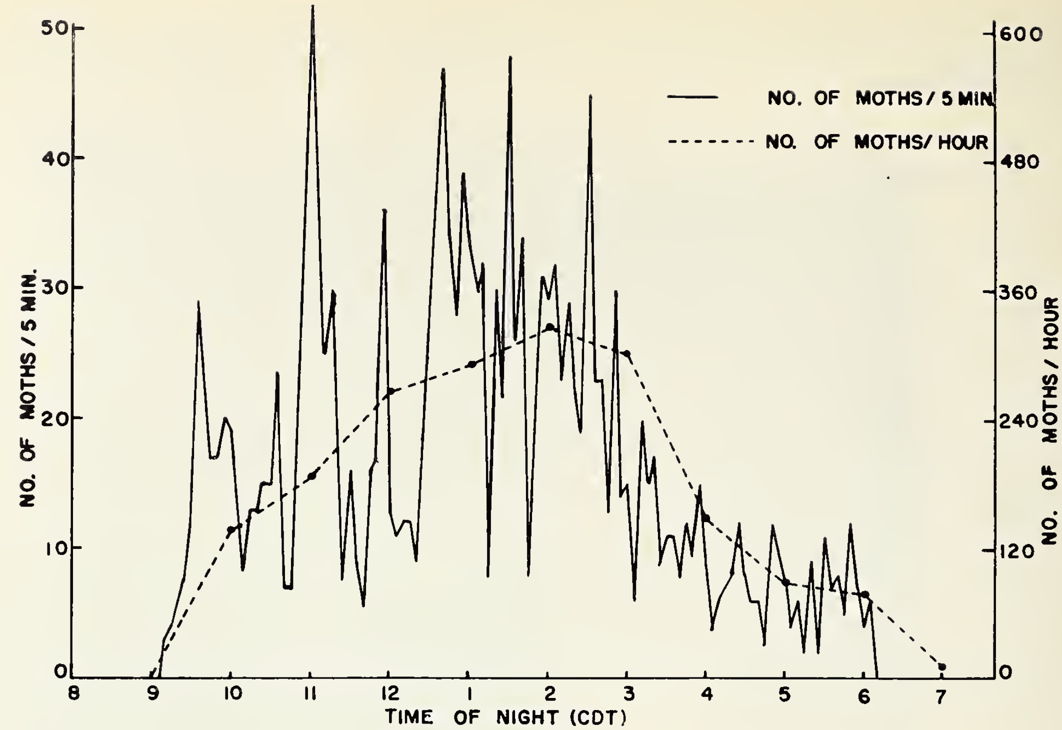

Figure 7.--Number of cabbage looper moths caught at night in 5-minute and 1-hour periods on August 3, 1967.

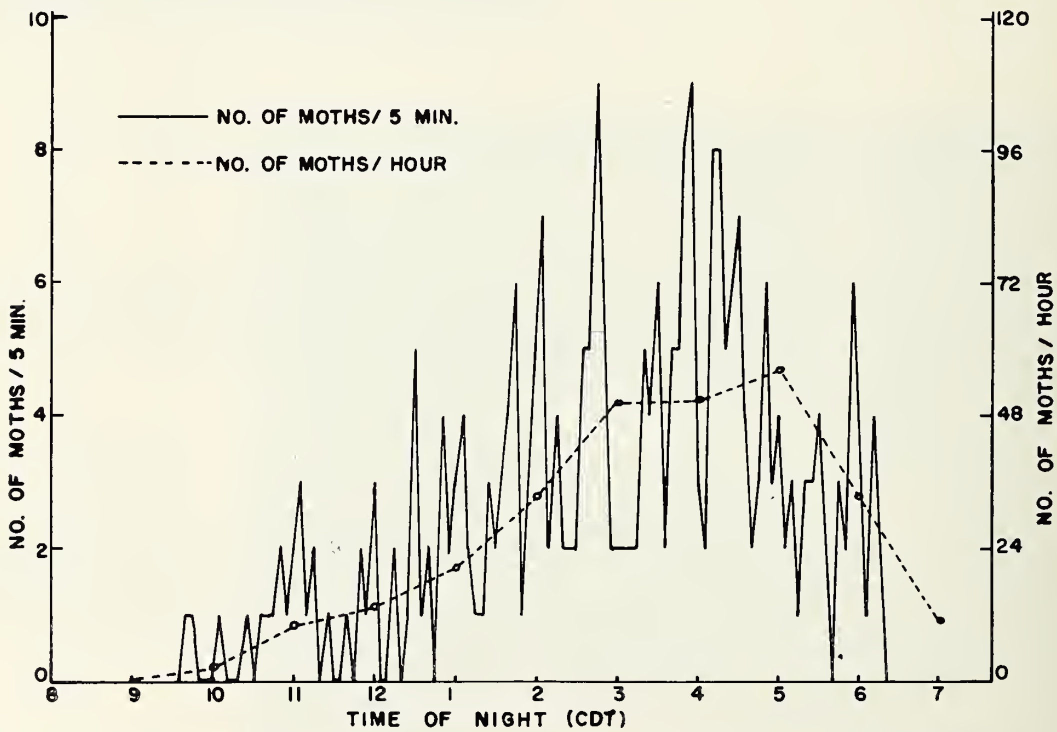

Figure 8.--Number of bollworm moths caught at night in 5-minute and 1-hour periods on August 3, 1967.

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