OPERATIONAL AND SCIENTIFIC NOTES

A MACHINE FOR DETERMINING THE RESISTANCE OF INSECT REPELLENTS IMPREGNATED IN CLOTH TO WASHING AND RINSING[1]

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An important consideration in the development of clothing repellents is the resistance of each chemical to leaching by water. This matter is of particular concern to the armed forces because troops may be exposed to heavy rainfall and are often required to wade through water.

At this laboratory, during the screening of compounds for their repellency to blood sucking arthropods, cotton stockings and patches are impregnated with candidate chemicals and tested against chigger mites, ticks, and several species of mosquitoes, (USDA Agric. Handbook 340, 1967). When a candidate chemical repels chigger mites in the initial pre-rinse test, it is rinsed in tap water (26°C) for 15 min, drip dried and retested. If the chemical is still effective, a fresh cloth is treated and washed in hot (50°C) water with 40 g of military issue, lye base, flake soap for 15 min, rinsed for 10 min in fresh tap water at 26°C, drip dried, and tested again for repellency. This wash, rinse, and test routine is repeated until the chemical is rendered ineffective, thus we can determine the durability of a chemical in resisting washing and leaching from the fabric. Routinely, groups of 10 to 12 chemicals are tested daily in duplicate. Therefore, if the washings and rinsings were done in a single unit, commercial washing machine, the procedure would be slow and time consuming. To expedite the procedure, we developed an agitating washing and rinsing machine by using the principles of the drive train assembly of a blood defibrinator described by Bailey et al. (1978). To facilitate the washing and rinsing of sample treatments on cloth, the mechanism was designed so that by using separate containers each sample could be treated in the same manner and also prevent chemicals from mixing with one another. The rotating and agitating of the containers produced the necessary wash or rinse cycles.

The rectangular base of the machine agitator frame assembly was formed by bolting 2 lengths of 186.7 cm and 2 lengths of 38.1 cm slotted angle iron together (Fig. 1). A third 38.1-cm length was bolted 7.6 cm from one end and a 1/3 hp, 1725 rpm, 115-v, AC motor was mounted there. A 5.1-cm pulley was installed on the motor shaft.

Twelve 1.3 x 45.7-cm pieces of cold rolled steel were used for the roller shafts and cam shafts. Six of these rolled steel rods were welded off center inside six 1.9-cm ID x 25.4-cm pieces of water pipe to form the agitating cams. The other 6 pieces were each fitted with 5 shaft collars inserted at even intervals to form the roller shafts (Fig. 1A). All of the roller and cam shafts (Fig. 1B) were inserted in a 31.8 x 2.5-cm ID piece of flexible tubing, PVC, NALGON® size 35. Twenty-four sealed ball bearing pillow blocks (Fig. 1C) with 1.3-cm bores were used to attach the roller and cam shafts at alternate positions on the frame. Each cam shaft was spaced according to the desired v-belt tension, and each roller shaft center was spaced 16-cm from the cam shaft center. Also a piece of double sticky side carpet tape was wrapped around each cam shaft cover to prevent the containers from slipping on the rollers.

The first cam shaft next to the motor (Fig. 1B) had a 20.3-cm drive pulley and a 10.2-cm pulley installed side by side on the shaft (Fig. 1D). A v-belt (DEMCO® 4L340) connected the 5.1-cm motor pulley to the 20.3-cm pulley. The last cam shaft had one 10.2-cm pulley; the other four cams had two 10.2-cm pulleys side by side on each shaft, and these pulleys were connected with 5 TRUFLEX® 2330 v-belts. For smooth operation, some adjustment must be made in the cam shaft distances by loosening the pillow blocks, so that the tension on all v-belts is uniform.

A safety shield for the pulleys and belts (Fig. 1E) was formed from a 50.8 x 189.2 x 0.10-cm sheet of aluminum. It had a 10.2 cm wide top and 20.3 cm sides. The back of the shield was

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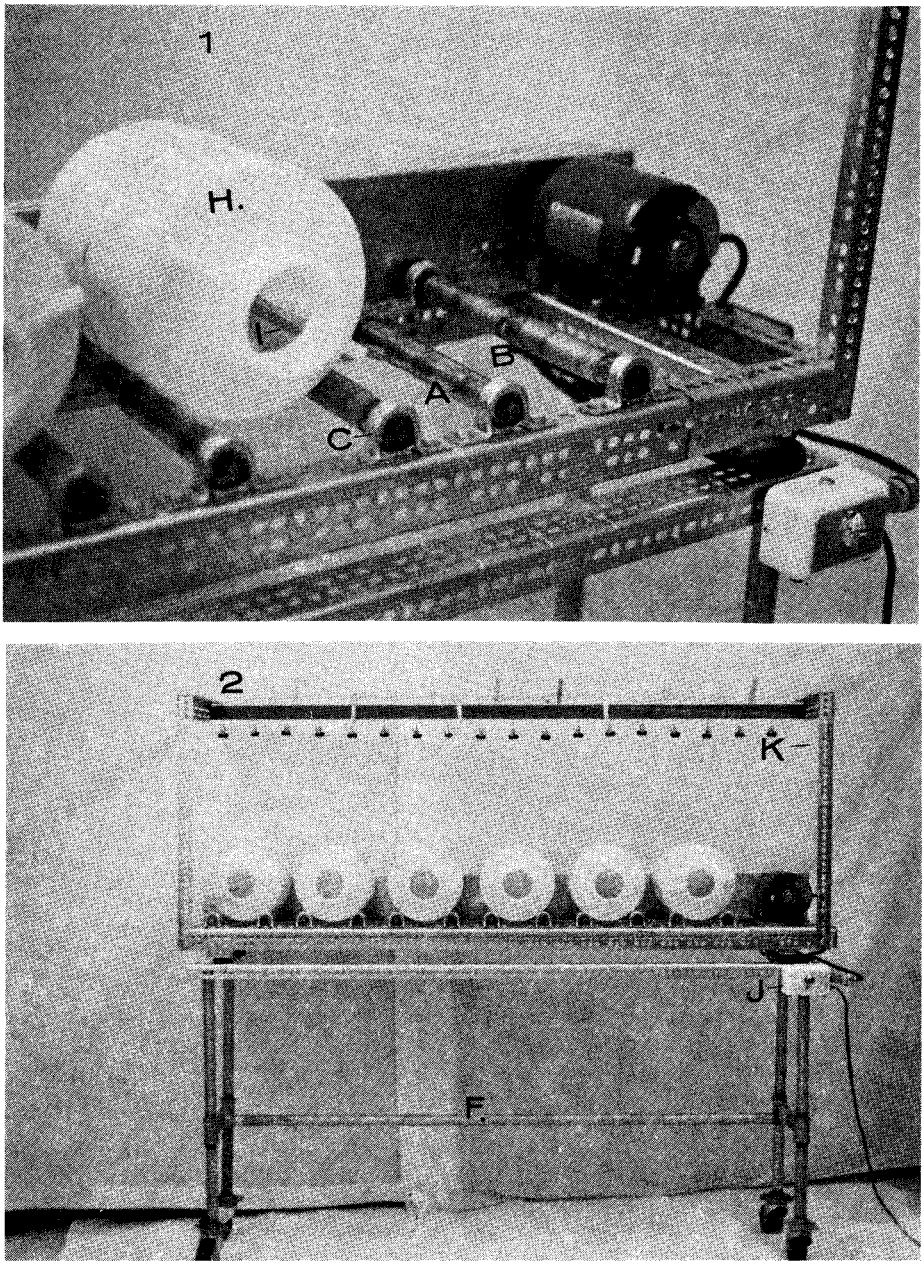
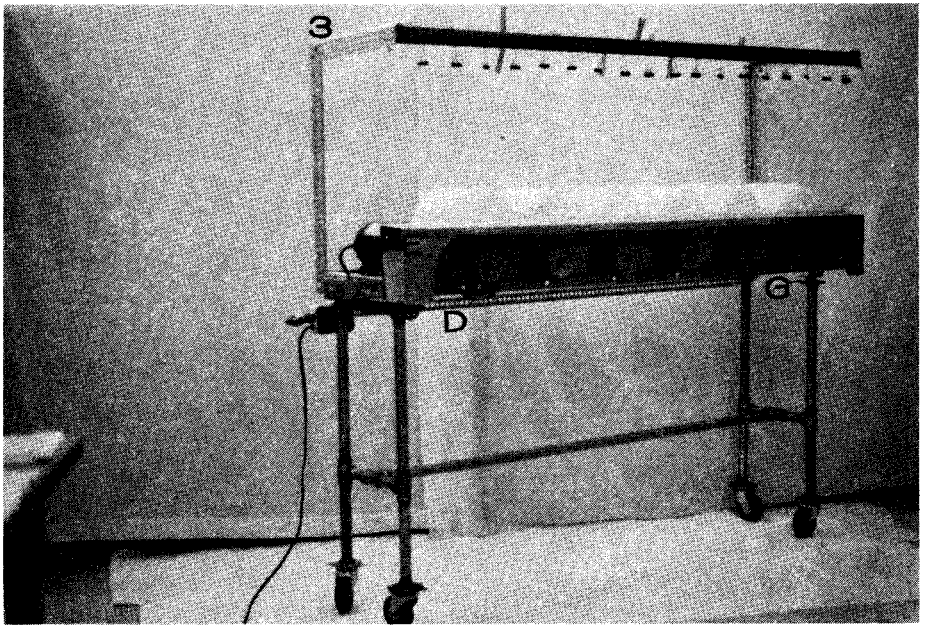


Figure 1. Various views of washing machine: (1) Closeup; (2) Front; (3) Rear view of machine for washing and rinsing.

(A) Roller shaft, (B) Cam shaft, (C) Pillow block, (D) Drive pulleys, (E) Safety shield, (F) Stand, (G) Rubber stopper, (H) Carboy, (I) Aluminum fin, (J) Automatic timer, (K) Drying rack.



cut out to allow access to the pulleys and belts and recesses were cut out of the opposite side to correspond with each shaft. At each end of the shield, a 0.10 x 14.0 x 15.2-cm aluminum U-bracket was inserted to reinforce it. The safety shield was attached to the angle iron frame. Pieces of 2.5 cm slotted angle iron were used as braces and were bolted to the side of the shield and the top of the frame to give added stability.

The stand (Fig. 1F) was constructed of 2.5-cm threaded water pipe. The leg assembly consisted of four 47.0-cm upper leg sections, four 26.7-cm lower leg sections, four 11.4-cm crossmembers, one 170.2-cm stretcher, and one 186.7-cm slotted angle iron top brace. The legs and crossmembers were assembled by using six 2.5 cm water pipe "T" joints and eight 8.9 x 2.5-cm water pipe flanges. At each corner of the agitator frame assembly a 7.6-cm piece of slotted angle iron was bolted on as mounting brackets. A 3.8-cm diameter rubber stopper was placed between each of these mounting brackets (Fig. 1G) and the upper four flanges of the leg assembly by attaching a bolt through the center of each rubber stopper so that it served as a shock absorber. Rubber wheel castors (10.2 cm) were bolted to the 4 lower flanges of the leg assembly.

The agitating containers were 6 wide-mouth NALGENE® carboys (Fig. 1H) with a 8.9-cm diameter mouth and a 8-liter capacity. Each carboy had 2 aluminum fins (0.10 x 11.4 x 20.3 cm) with a 1.0-cm lip bent at a 90° angle popriveted to opposite sides of its interior (Fig. 1I).

When the machine is prepared for use, the carboys are filled with 4.55 liters of rinse or wash water, the treated cloth is added, and the carboys are tightly capped and placed horizontally on the cam and roller shafts. As the cams turn, the carboys are rotated and lifted so the fins inside give the water a lift and tumble action.

An optional automatic adjustable timer (Fig. 1J) was installed to shut off the machine at the end of each wash or rinse cycle.

A drying rack (Fig. 1K) was constructed of two 72.4-cm lengths and two 49.5-cm lengths of slotted angle iron. Each 12.4-cm length was bolted to a 49.5-cm length to form two "L"s. The "L"s were bolted upside down on each front corner of the machine frame with the short crossmember directly over the machine. A wood slat 1.3 x 5.1 x 186.7 cm was screwed in across the back side to connect the two "L"s. Three lengths of wire were evenly spaced and stretched between the angle irons to serve as drying lines.

Larger or smaller units can be built by using the principles described. Except for minor adjustments the machine has been very satisfactory in operation.

The following is a list of materials necessary to build the described apparatus:

24 Sealed ball bearing pillow blocks with 1.3-cm bores
1 Pulley 20.3 cm
1 Pulley 5.1 cm
10 Pulleys 10.2 cm
5 V-belts Truflex® 2330
1 V-belt Demco® 4L340
30 Shaft collars, 1.3-cm bore
6 Lenghts water pipe 1.9 cm ID x 25.4 cm
12 Lengths cold rolled steel shafts 1.3 x 45.7 cm
12 Lengths flexible tubing PVC, Nalgon® size (31.8 cm x 2.5 cm ID)
1 Roll carpet tape
1 AC motor 1/3 HP, 1725 rpm, 115-V
1 Shut-off timer and buzzer ¼ HP, 120-V, 1600-W
3 Lengths slotted angle iron 186.7 cm
3 Lengths slotted angle iron 38.1 cm
4 Mounting brackets of slotted angle iron 7.6 cm
8 Shield mounting brackets of slotted angle iron 2.5 cm
1 Box slotted angle serr. nuts & bolts 3–8 x 5–8
2 Lengths slotted angle iron 72.4 cm
2 Lengths slotted angle iron 49.5 cm
1 Length wood slat 1.3 x 5.1 x 186.7 cm
4 Rubber wheel castors 10.2 cm
4 Rubber stoppers 3.8 cm diam.
6 Pipe, "T" joints 2.5 cm
8 Pipe, flanges 2.5 cm x 8.9 cm diam.
1 Length pipe 2.5 x 170.2 cm
4 Pipe, end pieces 2.5 x 11.4 cm
4 Pipe, leg pieces 2.5 x 47.0 cm
4 Pipe, leg pieces 2.5 x 26.7 cm
1 Sheet aluminum (pulley & belt shield) 50.8 x 189.2 x 0.10cm
2 Sheet aluminum end brackets 14.0 x 15.2 x 0.10cm
12 Sheet aluminum fins 11.4 x 20.3 x 0.10 cm
1 Box Pop-Rivets®, grip range 0.3 x 0.3 cm
6 Carboys, wide mouth with handles, Nalgene®, 8.9 cm diam. mouth, 8 liter capacity

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THE MALE REPRODUCTIVE SYSTEM OF THE BLACK FLY, *SIMULIUM PICTIPES* HAGEN[1]

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Thorough reports of genital tract development and spermatogenesis in the Simuliidae are relatively rare. Aside from scattered gross morphological descriptions of the male reproductive system (see Ramirez-Perez 1977), and several accounts describing chiasmal aspects of meiosis in subarctic species (Rothfels and Mason 1975, Rothfels and Nambiar 1975, Procunier 1975), very little histological-cytological information is available for this important group of biting flies. Because a better understanding of the reproductive processes in black flies is necessary for behavioral and colonization research, we studied the microanatomy of the reproductive tract of *Simulium pictipes* during the pupal and early imaginal stages. Descriptions of basic developmental steps are given here and comparisons are made with related Diptera.

PREPARATION OF MATERIAL. Larvae were collected in Tompkins Co., N.Y. and reared in the laboratory (Muirhead-Thomson 1968). Specimens were fixed in Bouin's fluid and embedded in paraffin. Sections approximately 6 μm thick were cut with a rotary microtome. Hematoxylin and eosin were used as stains.

OBSERVATIONS. The testis in a pharate pupa is a well-developed ovoid structure with an anuclear sheath and a closely adherent fat body (fig. 1). The anterior half of the organ consists of spermatogonia and spermatocytes; the posterior is filled with spermatids in various stages of differentiation. Occasionally

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