

A REGULATED PRESSURE SPRAYER FOR MALARIA CONTROL OPERATIONS

by

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Commercial type hand sprayers were used in 1945 when Georgia DDT residual spraying operations were begun. Sprayers of this type were not designed for continuous use with xylol base emulsions. As a result, frequent delays were encountered due to failure of the pumping mechanism, the ring type gaskets or soldered joints in the sprayer tank. Also, the frequent pumping necessary to maintain satisfactory air pressures required considerable man power reducing the amount of time that could be spent on actual spraying operations.

The basic design of the available sprayers made it difficult to maintain consistent or uniform application rates of the DDT emulsions. Spraying procedures were based on the use of a fan-type spraynozzle (Spraying Systems Company 1/4T-8002) which discharged 0.2 gpm (gallon per minute) at 40 psi (pounds per square inch) pressure. With the single compartment sprayer the air pressure could not be maintained at exactly 40 psi. Therefore, it was necessary to adopt a procedure that would result in an average discharge of 0.2 gpm. The procedure was to load a fourgallon sprayer with two gallons of emulsion and then pump the sprayer until a pressure of approximately 50 psi was obtained. Under this pressure, the nozzle discharges approximately 0.22 gpm with an 82° spray pattern. After one gallon of emulsion was discharged, requiring approximately five minutes, the air pressure was reduced to approximately 33 psi. Under this pressure, the nozzle discharges approximately 0.18 gpm with a 77° spray pattern. At this time, the air pressure was restored to approximately 50 psi and the remaining gallon of emulsion discharged without further repumping. As may be noted, the initial and final discharge rates (0.22 and 0.18 gpm) varied from the designed discharge rate (0.20 gpm) by 10%. This was considered to be the maximum permissible tolerance.

Xylol-resistant gaskets and other appurtenant rubber fittings were obtained and installed on all hand sprayers. Also, during the 1945 season, the air pumps were

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removed and the hand sprayers were equipped with air filling valves. Each spray truck was equipped with a reserve air tank (40 to 80 gals. capacity, filled from commercial or privately owned compressors) in order to intermittently supply the hand sprayers with air through the air filling valves. The reserve air tanks were equipped with tire inflators (Tru-Flate No. 711) with which the air pressure in the hand sprayer could be measured and also increased to the desired pressure. While these changes in equipment improved the production rate about 30% to 40%, by eliminating the manual pumping operations and reducing maintenance delays, the objections of varying air pressures and consequent varying discharge rates were not overcome.

In July 1946, a sprayer was designed which eliminated the objectionable features of the modified commercial sprayers. It was designated as the "Regulated Pressure" (RP) sprayer. It was composed of two 500 cubic inch (approximately 2 1/6 gals. capacity -5" diameter x 23 1/4" long) tanks (surplus U. S. Army Air Force type, designed for working pressures of 400 psi). One was used for air storage and the other for emulsion. An air filling valve was incorporated in the air tank which, through a pressure regulator (Watts Regulator Company No. 26 AC 1/4") and stopcock, was connected to the  $1 \frac{1}{2}$  nipple in the emulsion tank. The 1 1/2" emulsion tank filler opening  $(1 \ 1/2"$  nipple — silver soldered) was equipped with a commercial pipe-cap fitting to which a handle had been welded. In this cap was incorporated a solid circle Xylol-resistant gasket for maintaining an air tight seal.

The emulsion tank was equipped with a 1/4" bottom discharge outlet made with a 1/4" street ell fitting. A 1/4" (outside diameter) copper tube protruded from this outlet approximately 3/4" into the emulsion tank. Thus, small quantities of trash and other sediment were retained in the tank. This prevented entrance of these materials into the outlet hose and clogging of the nozzle strainer. A 1/4" ID Xylol-resistant hose, approximately 51/2' long was attached

to the discharge outlet by means of a 1/4" hose bib. To the hose were attached a shutoff valve (Hudson), 1/8" pipe wand (18" to 30" length) and nozzle (Spraying Systems Company 1/4T-8002).

The air and emulsion tanks were banded together (with 1/2" rubber separators) and incorporated into the carrying frame composed of a 2"x6"x8" wood block and 5/16" black iron rod. The assembled sprayer was manually transported by means of a web sling, permanently or temporarily attached to the carrying frame.

Figure 1 illustrates the carrying position of the sprayer; Figure 2 illustrates the air and emulsion loading of the sprayer from a typical crew truck; and in Figure 3, an exploded view of a sprayer, with key letters, is shown. The keyed component parts of the sprayer are shown in Table 1. Figure 4 illustrates accessory equipment (described in Table 2).

Before issuance to Georgia field crew personnel, the pressure regulators were set to maintain an air pressure of 40 psi in the emulsion tank.

In operating the RP (Regulated Pressure) sprayer, after closing the stopcock (W) and removing the filler cap (G), either tank may be first filled or both may be filled simultaneously. The air tank should be filled with air (from the reserve air tank) to obtain a pressure of at least 85 psi. With this initial pressure, the entire contents of the emulsion tank may be discharged at a uniform pressure of 40 psi. With an initial pressure of 125 psi, two tankfuls of emulsion may be discharged at 40 psi. After filling the emulsion tank, the filler cap is securely attached and the stopcock opened.

All, or a portion, of the emulsion contained in the emulsion tank now may be discharged at a uniform pressure of 40 psi. In reloading the emulsion tank, which may be entirely or partly empty, the stopcock is closed before the emulsion tank air-pressure is released by removing the filler cap. In Georgia operations, the emulsion tank is refilled when empty, or when the tank contains less than one-half gallon of emulsion after an individual spraying is completed. Air tank pressure is restored to at least 85 psi whenever emulsion is added.

In spraying operations, the usual carrying position is as shown in Figure 1 with the sling over the left shoulder. the RP sprayer on the operator's back, with the shut-off valve held in the right hand. Some operators utilize two slings with one over each shoulder and others carry the RP sprayer under one arm, partially supported with one hand.

It should be noted that considerably less air volumes are required in operations utilizing the RP sprayer than in those utilizing single compartment sprayers. To discharge one gallon of emulsion from the RP sprayer, only one gallon of air at 40 psi is required while with other sprayers, a minimum average air volume of 1.6 gallons at 40 psi

is required. The RP sprayer requires very little maintenance as judged by 1947 operations. RP sprayers were used for about three-fourths of the season during the whole of which 218,245 units were sprayed with a total of 568,971 gallons of emulsion.

No particular difficulty has been encountered in training unskilled men to operate the RP sprayer, and at least 90% of the crew members prefer it to other sprayers. Its greater weight (total -19 lbs.) was considered objectionable originally, but few complaints on this score were received from field operators.

Operations data for 1947 indicate that the daily emulsion output per man using the RP sprayer is at least 80% greater than when using the commercial type sprayer with hand pumps. Counting spray time as the total time spent at individual spraying sites, which includes mixing, loading and



Figure 1. The Regulated Pressure sprayer ready for use. The carrying

position of the sprayer is well illustrated here.

spraying operations, the RP sprayer emulsion output (using 8002 nozzle - 40 psi) will range from six to 8.4 gallons per manhour, depending upon the ability and teamwork of the crew members. Under rural Georgia conditions, the spray time will account for approximately 70% of the gross crew-time, with the remaining 30% utilized in travel and warehouse operations.

## SUMMARY

1. A Regulated Pressure Sprayer has been designed. Approximately 500 were constructed and utilized on 1947 DDT residual spraying operations on the Georgia Malaria Control program which included 218,245 unit sprayings.

2. In comparison with single compartment sprayers, the demonstrated advantages of the RP sprayer are:

- a. It permits the discharge of spray solution or emulsion at a uniform pressure and discharge rate.
- b. The uniform discharge rate expedites

crew training and improves the uniformity and consistency of surface application rates.

- c. It requires a lower volume of air per unit volume of emulsion or solution discharged.
- d. It requires less judgment and manual labor to operate.
- e. Maintenance requirements are less and it may be constructed by an individual agency.
- f. It considerably improves the efficiency of manual spraying operations.

3. The RP sprayer has been used on only small-scale larviciding operations, but its advantages on such operations paralleled those noted on residual spraying operations.

4. The regulated air pressure — two compartment principle may be applied to the design and construction of sprayers utilizing different size air and liquid tanks, with higher or lower spray pressures.



Figure 2. Air and emulsion loading of the sprayer from a typical crew truck.

## Courtesy of the David J. Sencer CDC Museum



Figure 3. The Regulated Pressure Sprayer dismantled. For key, see next page.

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## TABLE 1

FIGURE 3 KEY LETTER	NUMBER REQUIRED	, DESCRIPTION
А	1	Nozzle (Spraying Systems 1/4T-8002).
В	1	Wand $-1/8$ " Pipe, 18-30" in length, fitted with $1/8$ " x $1/4$ " bushing and $1/8$ " x $1/4$ " reducer.
С	1	Shut off valve (Hudson ).
D	1	Outlet hose $-1/4$ " ID, 5 1/2' long, Xylol resistant and equipped with hose clamp at both ends.
E	1	Hose bib, 1/4" male thread.
, F	1	Street ell fitting, $1/4$ " with 2" length of $1/4$ " OD copper tube installed in male end.
G	1	Pipe cap, 1 1/2" equipped with handle made of 5/16" iron rod.
Н	1	Gasket, 1/2" thickness, 1 1/2" diameter full circle, xylol resistant material.
I	1	Pipe nipple, $1 \frac{1}{2}$ diameter, approximately $1 \frac{1}{2}$ long, upper end threaded, side tapped and threaded for $1/4$ SAE thread.
, J	1	Emulsion Tank, 5" diam. by 23 $1/4$ " length (U. S. Army Specifications No. 94-40355, Type D-2) with $1/4$ " female fitting at lower end and modified by cutting 1 $1/2$ " diameter hole in center of upper end.
K	1	Carrying frame made of $5/16''$ iron rod and composed of 2 uprights $(K_1)$ , 5" cross brace $(K_2)$ and base $(K_3)$ .
L	1	Base block, $2" \ge 6" \ge 8"$ , with hole and notch to clear bottom fittings of air and emulsion tanks.
М	1	Pipe plug, 1/4".
N	1	Sling, $1 \frac{1}{2}$ to 2" width, approximately 36" long and equipped with snaps or buckles at either end.
0	2	Banding straps, approximately 1/32" x 3/4" x 34" long.
Р	4	Strap seals, 3/4" (Acme Steel Company No. 61 S).
Q	1	Air tank, same as J except that upper and lower end fittings consist of $1/4$ " female fittings.
R	1	Pipe nipple, 1/4" close.
S	1	Pipe tee, 1/4".
Т	1	Air filling valve, (Schrader or equal).
U	1	Pipe nipple, 1/4" close.
V	1	Pressure regulator, 1/4" (Watts Regulator Company No. 26AC 1/4").
W .	1	Stopcock, 1/4".
Х	1	Flexible connection, composed of 4" length of $1/4$ " OD copper tubing; $2 - 1/4$ " female couplings; $1 - 1/4$ " SAE male connector.
Y	1	Carrying grip, 4" length of used hose either 1/4" or 3/8" ID.
Z	2	Separators, 1/2" x 1 1/2" x 2 1/2".

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Figure 4. Accessory equipment described in Table 2.

## TABLE 2

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FIGURE 4 KEY LETTERS	ITEM DESCRIPTION
AA	Testing Cap $-1 1/2$ " pipe cap with dial gage (0-200 psi) connection to measure emulsion tank air pressure.
BB & CC	Side and top views of funnel used in straining emulsion as sprayer is filled.
DD	Block for holding shutoff valve plungers while removing defective tips.
EE	Tip inserter tool - portable type.
FF	Shutoff valve plungers without tips.
GG	Replacement tips for shutoff valve plungers.
HH & II	End and box wrenches (13/16') for separating nozzle.
JJ	Tip inserter tool - bench type.

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