MODIFICATIONS INCREASING EFFICIENCY OF HAND COMPRESSION SPRAYERS FOR MALARIA CONTROL [1]

FRED W. KNIPE [2]
The Rockefeller Foundation, New York, N. Y.

INTRODUCTION

Hand pressurized compression sprayers adaptable to residual spraying have undergone relatively extensive improvement since such spraying has become general. The demand by user agencies for improvement in performance, particularly with regard to ease and economy of operation, has stimulated continued efforts to meet more exacting specifications.

This specialized equipment, developed for a specific program, is now finding a market in the agricultural field as well. For instance, the pressure regulator, which is widely used on compression sprayers in malaria eradication programs, is being adopted as standard equipment by certain tea estates. This element assures a more even distribution of insecticides within the limits of the pressure for which it is preset. So far as is known it was first used on hand compression sprayers in India in 1942 (1, 2).

World Health Organization authorities, sitting as an Expert Committee on Equipment Development, from time to time have indicated the course to be followed in improving this type of sprayer. The Committee has sometimes made thought-provoking suggestions that resulted in modifications not previously mentioned by them. The present paper describes some of these improvements, which have been developed under the guidance of the author.

The standards established by the W.H.O. Committee must be closely followed. One of these specifies that the total weight of the apparatus may not exceed 12 pounds. Since nearly all present models of sprayers weigh very close to 12 pounds, it behooves the developing agency either to install something very light, or else to reduce weight in an existing element, in order to meet specifications. These are not always easy tasks.

During the past few years, various improvements in efficiency have been developed under the guidance of the author. Some of these improvements have made possible complete abandonment of certain elements and reduction of weight in others. Several of the newer elements are not yet in common use, and may not be incorporated commercially for several years because fabricators, for their own good reasons, are often loath to make changes in model design. A case in point again is the pressure regulator, which, so far as is known, was not installed on hand compression sprayers by any manufacturer until nearly ten years after its practical application was established.

It is the intention in this review to discuss the modifications proposed in terms of the reasons behind their development, the advantages and disadvantages which they provide, and their relation to the weight problem.

PROPOSED MODIFICATIONS

CLEAR PLASTIC TUBING

Plastic tubing, fabricated from polyethylene or polyvinyl chloride (P.V.C.),

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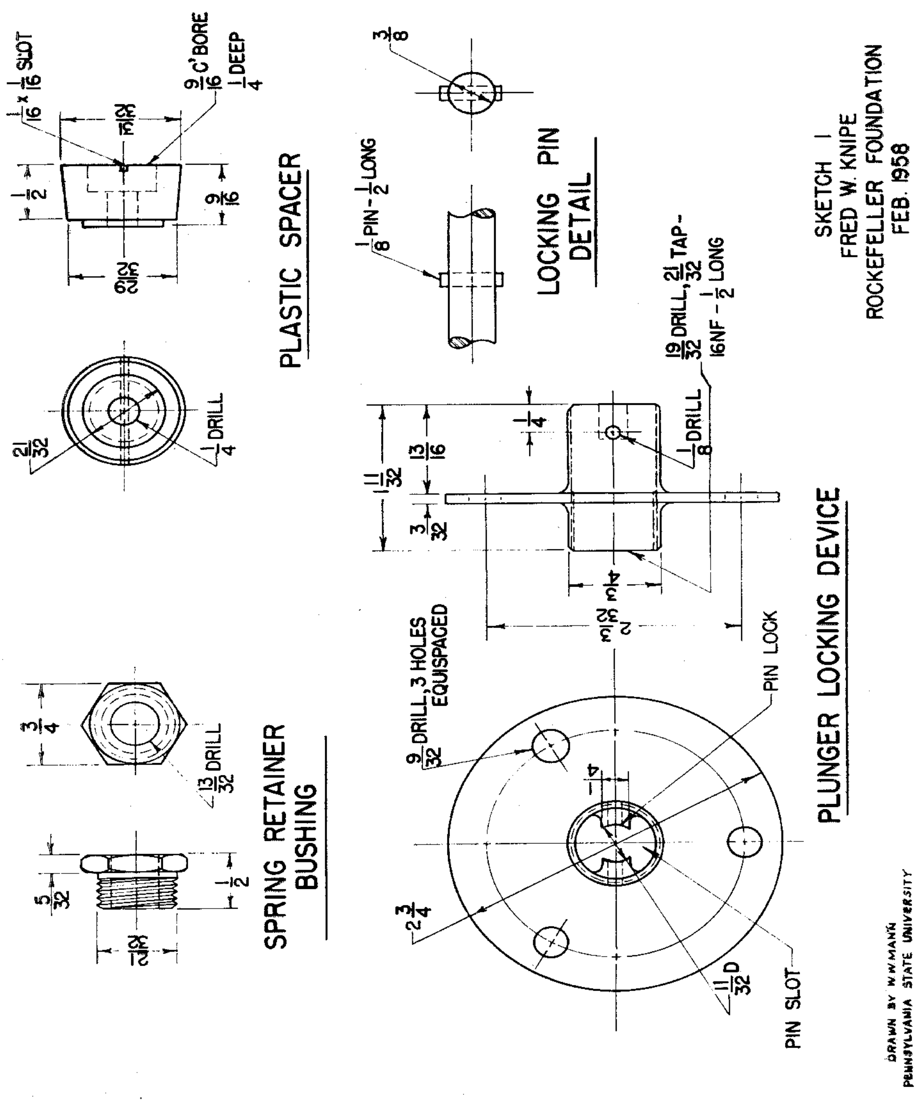
[1] Developed during the interval 1953–1957, with particular reference to residual spraying.

[2] Present address: 517 West Park Avenue, State College, Pennsylvania.


PLASTIC SPACER
1/16 x 1/16 SLOT
9/16 C'BORE 1/4 DEEP
21/32 DRILL
1/4 DRILL
LOCKING PIN DETAIL
1/8 PIN - 1/2 LONG
SKETCH I
FRED W. KNIPE
ROCKEFELLER FOUNDATION
FEB. 1958
19/32 DRILL, 21/32 TAP-16NF - 1/2 LONG
1/8 DRILL
SPRING RETAINER BUSHING
13/32 DRILL
9/32 DRILL, 3 HOLES EQUISPACED
PIN LOCK
PIN SLOT
11/32 D
PLUNGER LOCKING DEVICE
DRAWN BY W.W.MANN
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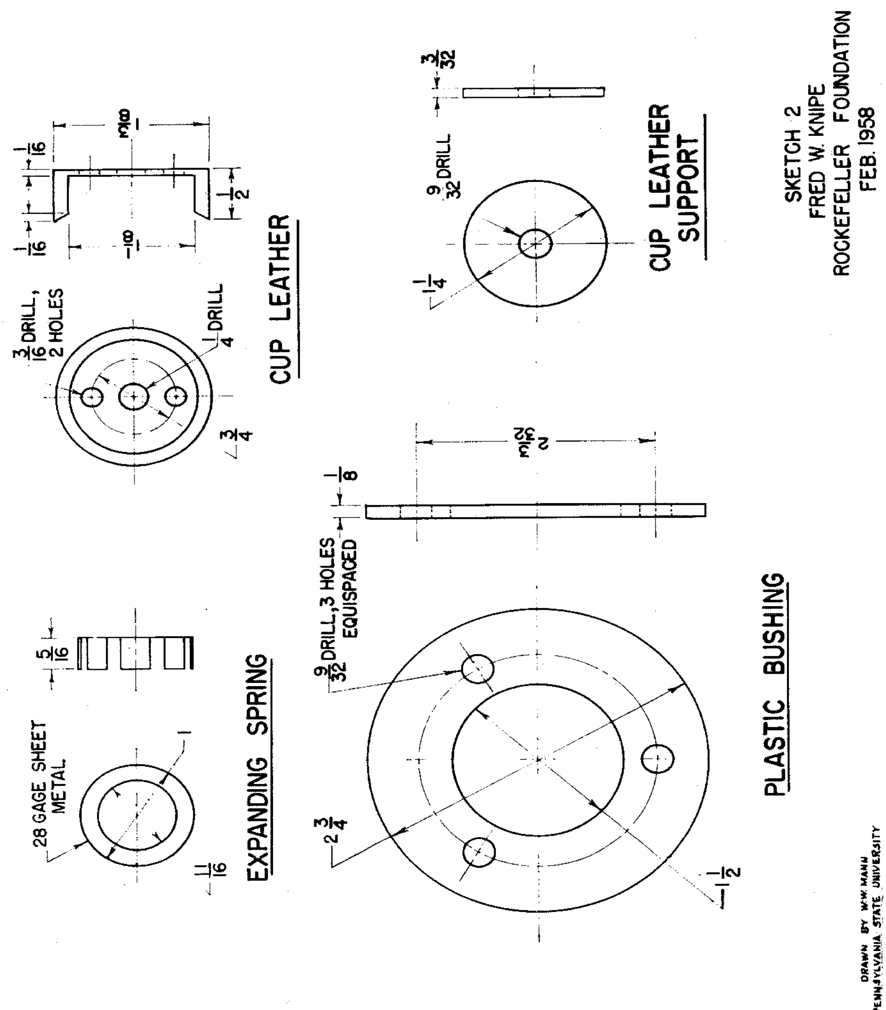
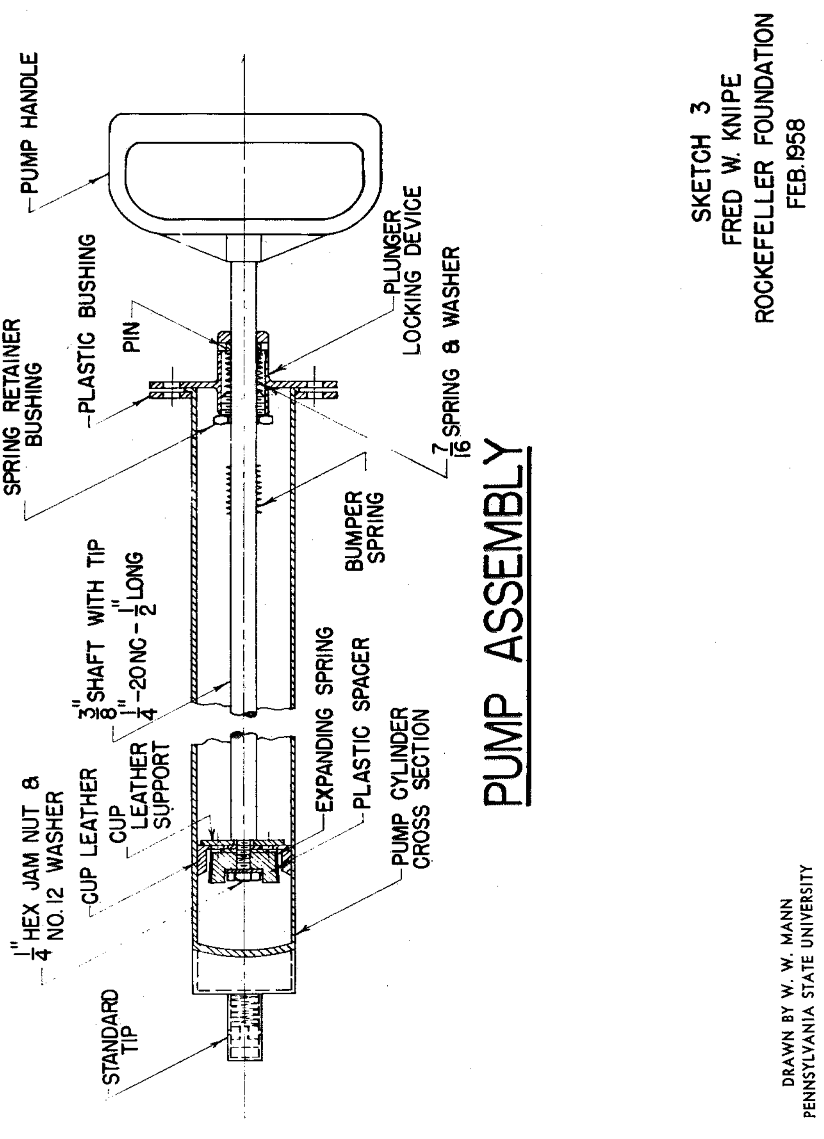


CUP LEATHER
3/16 DRILL, 2 HOLES
1/4 DRILL
3/4
1/16
1/2
CUP LEATHER SUPPORT
9/32 DRILL
1 1/4
3/32
SKETCH 2
FRED W. KNIPE
ROCKEFELLER FOUNDATION
FEB. 1958
EXPANDING SPRING
28 GAGE SHEET METAL
1
11/16
5/16
PLASTIC BUSHING
9/32 DRILL, 3 HOLES EQUISPACED
1/8
2 3/4
1 1/2
DRAWN BY W.W. MANN
PENNSYLVANIA STATE UNIVERSITY


PUMP HANDLE
SPRING RETAINER BUSHING
PLASTIC BUSHING
PIN
PLUNGER LOCKING DEVICE
7/16 SPRING & WASHER
BUMPER SPRING
3/8" SHAFT WITH TIP
1/4" -20NC - 1/2" LONG
CUP LEATHER SUPPORT
CUP LEATHER
1/4" HEX JAM NUT & NO.12 WASHER
EXPANDING SPRING
PLASTIC SPACER
PUMP CYLINDER CROSS SECTION
STANDARD TIP
PUMP ASSEMBLY
SKETCH 3
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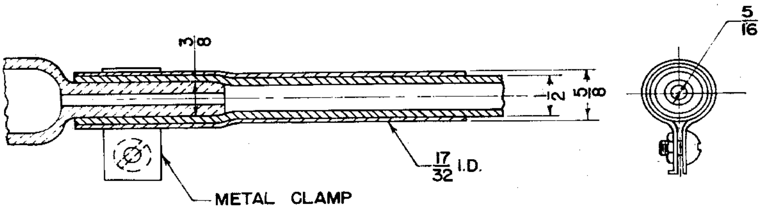
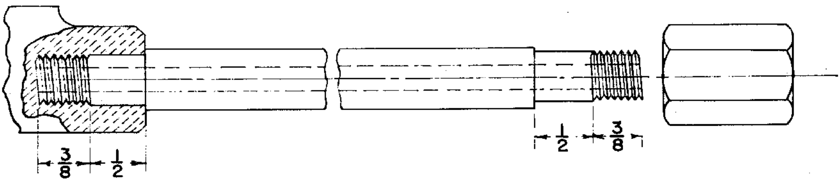


TUBING END REINFORCEMENT
(FLEXIBLE)



TUBING END REINFORCEMENT
(RIGID)

SKETCH 4
FRED W. KNIPE
ROCKEFELLER FOUNDATION
FEB. 1958

DRAWN BY W.W. MANN
PENNSYLVANIA STATE UNIVERSITY

has almost completely replaced rubber as the material of choice on malaria control equipment in India. It has been used in the field since 1953. The type is a clear transparent plastic, although it may be tinted slightly with any desired color. Opaque or opalescent tubing is considered less satisfactory, as will be explained later. So far as is known, plastic tubing was first used by the author on hand compression sprayers in Italy in 1946–47.

ADVANTAGES. 1. Low cost. The cost in India, where most of the trials upon which this report is based were made, is from 40 to 60 percent less than that for comparable rubber tubing.

2. Less weight. Plastic tubing weighs as much as 50 percent less than rubber tubing adequate for the same purpose.

3. Long life. Clear plastic tubing appears to have a longer life expectancy, under comparable working conditions, than locally procurable rubber tubing (in India), and has been found superior to rubber tubing on spraying equipment usually imported into India. In fact, during the past four years there has been practically no tube failure when plastics were used.

In this connection, it should be noted that opaque or opalescent types appear not to have the durability of the clear types. In local experience, opaque tubes have not withstood as high bursting pressures as clear tubing of the same wall thickness. The ordinary clear tube in use, 2.5 mm wall thickness, will withstand 170 to 200 p.s.i. bursting pressure.

4. Resistance to insecticides. At atmospheric temperatures, polyethylene and P.V.C. tubings are apparently not affected by insecticides used in malaria control formulations or by their solvents and diluents. In this respect the two materials appear to be considerably superior to locally procurable rubber tubing.

5. Ease in maintenance. Because the tubing is clear, the operator and the inspector can see the liquid passing through the tube and thus readily determine whether the tube has been properly cleaned.

DISADVANTAGES. 1. Plastic tubing of the desired types is sufficiently flexible at temperatures above 40° F. or 5° C. Below approximately this temperature, however, it tends to stiffen slightly, although it becomes flexible again when the temperature rises above 40° F. Since most residual spraying operations for malaria control take place at temperatures above 40° F., this disadvantage is of minor importance.

2. After long exposure to sunlight and weather, the tubing will slowly harden and may become slightly brittle. This point has caused no serious difficulty in five years of local operations and observations (in India and Sardinia). According to the fabricators, this disadvantage may be partially overcome by adding a quantity of tinting material to the plastic crystals at the time of manufacture. The hardening that takes place in some types of plastics when and as the plasticizer (softening material) "migrates" or evaporates is said to be retarded by the tinting.

TUBING END REINFORCEMENT

Tubing is subject to maximum wear and tear at the two points where it is attached: at the rigid element of the dip tube where it emerges from the tank, and at the fixed grip shank element of the cut-off valve (lance assembly). Rubber tubing often deteriorates in a period of weeks at these points. Plastic tubing wears considerably longer. Smaller diameters of plastics (1/4 to 3/16-inch internal diameter) may be easily reinforced at these points, with very small loss in flexibility, by placing a short length (6 to 8 inches) of greater diameter tubing over the full length tubing. Both tubing and reinforcing element are held in place by the usual hose clamp. Such reinforcing costs practically nothing and increases life expectancy almost indefinitely. (Sketch 4—Tubing End Reinforcement—Flexible.)

PLASTIC LANCE ASSEMBLIES

Complete lance assemblies have been fabricated from the plastic Tenite II

(C.A.B.) and have undergone successful field trials. The elements involved include: cut-off valve (with metal exceptions as noted); lance; goose neck; nozzle tip; and various male and female assembly couplings. The five elements within the cut-off valve assembly that are made from bronze or stainless steel are the fixed grip strainer, valve lever arm, valve fulcrum, valve pin, and valve assembly packing nut. Both clear and tinted types of Tenite II were investigated.

The first great advantage of a clear or tinted plastic lance assembly over metal types is ease of inspection and maintenance. One can see at a glance whether the assembly has been properly cleaned or where clogging occurs.

Another distinct advantage of an all-plastic over an ordinary bronze assembly is marked reduction in weight. The plastic assembly weighs from 12 to 16 ounces less than its all-metal counterpart. This is important when one considers that a lance assembly functions as a third class lever when in place in the operator's hand.

A third important advantage is that a plastic lance assembly costs from 40 to 60 percent less (1957) than a bronze model of similar construction.

Field trials with the plastic lance assembly have focused attention on several other noteworthy advantages. (1) The plastic tube, although considered rigid, is in reality somewhat flexible and does not remain distorted when bent (within the same limits) as does a metal lance. (2) It does not easily become distorted under a crushing load as does one made from metal.

A disadvantage, noted in the field trials, is that junction threads on the various elements, particularly on the cut-off valve, must be cut with more precision than is necessary with metal threads. Being slightly flexible, the plastic threads tend to strip or slide over each other. This fault may be overcome entirely by countersinking an unthreaded section of the connecting threaded male tubing into its female counterpart. (Sketch 4—Tubing End Reinforcement—Rigid.)

PLASTIC NOZZLE TIPS

Plastic nozzle tips have been under investigation for some time (3). Reasonably successful tips of this type that have been fabricated from Cellulose Acetate Butyrate (C.A.B.) and machine finished (discharge orifice), can now be procured.[3] Tips fabricated from P.V.C. are not yet available commercially. P.V.C. tips are superior to C.A.B. tips when durability is considered.

A plastic tip costs about Annas 4 ($0.05–1/4), as compared to Rs. 6 ($1.25) for a stainless steel tip. In other words, nearly 25 plastic tips can be purchased for the cost of one stainless steel tip. Development of plastic tips has been delayed by a seeming inability to mold or cut the tip orifice so that an acceptable discharge pattern will result. This difficulty has finally been overcome and plastic tip patterns are now as acceptable as locally machined (in India) stainless steel tips. Improvement is possible by developing close machining tolerances.

From the foregoing remarks relative to the development of plastics to a point where they may satisfactorily replace metallic lance assemblies and rubber hose, several points may be selected for emphasis. First, the price of plastic elements is approximately 50 percent lower than that of comparable metal parts. Second, plastic tips are very inexpensive compared to stainless steel tips (an important factor in a huge program such as is under way in India). Third, plastic hose and lance assemblies weigh considerably less than those made of rubber or metal. Fourth, plastic elements appear to be much more durable than their metal counterparts, particularly with respect to damage. Fifth, plastic hose and lance assemblies permit quick inspection and thus help to insure a clean working discharge line.

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[3] From Dominion Plastics Co., Bombay, or from American Spring and Pressing Co.. Bombay (Madras), India.

SWINGING PLASTIC DIP TUBE

Through the dip tube, contents of the spray tank are conveyed to the external discharge line. Dip tubes usually have been made of bronze or brass. Sometimes these are permanently fastened in place inside the tank in order to prevent damage; in other instances the tube hangs suspended from the upper end, its rigidity being relied upon to hold it in position. In cases where a filter is attached to the intake end the tube cannot be held permanently in place, since the complete assembly (tube and strainer) must be regularly removed for cleaning.

Two disadvantages are inherent in metal tubes. First, complete discharge of the tank contents often does not take place because operators do not always carry the tank in the proper position; furthermore, the tube is frequently cut off well above the tank bottom and thus liquid below the tube end cannot be discharged. Secondly, the tube is heavy. It must be so in order to retain rigidity, resist distortion, and assure long life.

Both points are relatively minor and can be corrected easily by substituting a flexible plastic tube of the proper length. This tube slides over the bottom of the tank regardless of the position in which the tank is held—so long, of course, as it is held with the bottom downward—and thus insures complete tank discharge. Development practice of this procedure has been to use a few inches of rigid plastic tubing on the intake end of the dip tube in order to prevent "curling" of the flexible tubing.

When necessary, either the conventional metal intake strainer may be mounted onto the plastic tube or a plastic strainer may be substituted.

A "swinging" plastic dip tube weighs several ounces less than a metal tube, has a comparably long life, and is lower in both original and replacement cost. This is a point where a few ounces saved permits development of features which may add weight.

PUMP PLUNGER CUP MODIFICATION

The pump plunger cup consists of three elements: cup leather; cup leather spring that holds the cup in shape; and assembly nuts and washers that attach the cup leather to the plunger rod. As the name "cup" implies, this element does contain a hollow, cup-like section which is pointed toward the pressurized end of the assembly. When in operation, this cup should come to rest at the extremity of the pressure stroke in order to secure full pressurizing benefit from that stroke. Since tank pressurizing by hand is a tiring job, the apparatus should be so constructed as to reduce the total number of full plunger strokes required to attain full maximum pressure.

Practically all sprayer models fail in this respect in that they allow air under pressure to remain in the cup at the end of the pressure stroke. When 40 or more p.s.i. have been developed in the tank, the residual pressure in this small cup begins to assert itself. This point may be noted by the operator's releasing his grip at the end of the pressure stroke, whereupon the plunger will rebound upward, sometimes as much as half the length of the pump cylinder. Rebound is due to the pressure in the cup, provided the foot valve is not leaking (inexcusable under any circumstance). Pressure, once developed, remains in the cup and is wasted.

Repeated trials have proved that from five to eight full pumping strokes may be wasted in this way when pressurizing a tank to 50 p.s.i. with 50 full strokes of the plunger. Even five wasted strokes represent a ten percent loss in pumping efficiency.

This faulty design may easily be remedied by placing a heavy, slightly tapered, plastic gasket of a "bumper" type inside the leather cup supporting the spring. The gasket is held in place by a conventional nut and metal washer inserted in a recess cut into the plastic. (Sketch 3—Pump Assembly; Sketches 1 and 2—Detail Drawings.)

A flexible type of tough plastic such as P.V.C. should be used. The gasket is cut to a diameter sufficiently large to fit snugly inside the expanding spring. In thickness, it should be adjusted so that it lightly touches the floor of the pressure cylinder. At the end of the stroke this flexibility crushes into and fills the remaining space between the plastic and the supporting spring, thus forcing practically all compressed air into the main tank cylinder (Sketch 3).

This device has been successfully tested. It is cheap, easily replaceable, and adds practically no weight to the apparatus. Increased efficiency is worth the added bit of weight.

Even with modifications made to the plunger cup, a full stroke cannot be guaranteed unless the plunger locking device at the handle end of the rod functions properly. Many commercial sprayers are equipped with a locking device—to hold them in place after the pumping cycle—that does not readily permit a full downward stroke. When the male section of the locking device attached to the plunger rod strikes the fixed or female element attached to the tank top, it does not enter it, with the result that one-half inch or more of the downward stroke may be lost.

The fault may be entirely overcome by means of the locking device illustrated in Sketch 1 (Plunger Locking Device). This device has been widely and successfully used on certain models manufactured in European countries.

The principle of construction involves inserting a small hardened pin (the male element) into the plunger shaft in such manner that it will pass into the pump cylinder cap (the female element of the lock), where it strikes a washer-protected locking spring. The main purpose of this locking spring is to hold the two elements together at the end of the pumping operation. Locking takes place at the end of the pressure stroke by a slight turn of the plunger handle. This turn places the pin under the pin lock, as illustrated in the sketch. The pin lock shoulders block a comparatively small arc of the female element of the device. Entrance of the pin into the slots provided for it is practically guaranteed by the principle of construction, and a full downward plunger stroke is thus assured.

Pressure Gauge Protection by Means of a Modified Sylphon Tube

The reasons why pressure gauges on malaria control equipment so often fail have been discussed in a previous paper (4).

A device to overcome most causes of failure has now been perfected. It consists of a short length of flexible plastic tubing properly attached to the pressure gauge. The added device has been designated a "Modified Sylphon Tube."

The plastic tubing of appropriate length (any convenient short length will do) is firmly attached to the shank extension of the gauge. Care must be taken that the outer diameter of the entire assembly is slightly less than the threaded gauge attachment shank in order to prevent damage when the gauge is attached to the tank. The tube must be permanently attached in a manner that prohibits any possibility of leakage. One way to achieve this is to use a threaded taper collar which compresses the tube firmly in place over the gauge shank attachment collar (Sketch 8). The internal diameter of the tube may vary according to the shank collar but depends somewhat on the size of the threaded gauge shank. The models developed and tried in the field were all attached to gauges with 1/8-inch shanks. The internal diameter of the tube was 5 mm and the external, 5.5 mm. Clear plastic tubing was used.

The opposite end of the tube—the end away from the gauge—is closed by means of a tapered bronze screw which passes into the tubing via a complementary bronze collar. This assembly must also be sufficiently small in diameter to pass through the gauge-to-tank attachment port. In other words, it must be smaller than the gauge shank.

For the modified sylphon attachment to function properly, the sylphon tube and all closed elements of the pressure gauge, including the Bourdon tube, must be completely filled with a liquid of low viscosity. The liquid must have no corrosive effect either on the plastic or on the gauge elements. Water was successfully used on all trial models, both in the laboratory and in the field. If water is used, it must be boiled first in order to expel any air that may be present. Good quality hydraulic brake fluid appears well suited for this purpose.

Since the diameter of the tube opening is small, liquids do not enter readily. This difficulty is overcome by filling it with a hypodermic syringe having an unusually long needle. Special care must be exercised to force all air out of the Bourdon tube as well. Once completely filled with liquid and securely sealed, the apparatus can be attached to the sprayer tank in the normal manner. In order to facilitate further complete filling of the element, a short length of very small gauge flexible plastic tubing may be attached to the needle. This may be pushed around the U-bend in the metal tube, thereby permitting liquid to be pumped into the inner extremity of the Bourdon tube.

In action, as pressure is developed in the sprayer tank it is automatically transferred through the liquid in the modified sylphon to the pressure gauge. Since the modified sylphon is a self-contained unit, no insecticidal material can enter the pressure gauge, be deposited there, and thus interfere with operation.

This instrument was tested in the laboratory by repressurizing a sprayer tank, containing a standard DDT formulation, five hundred times. The very worst possible conditions were created in the tank insofar as wear on the instrument and possibility of contamination were concerned. There was no sign of failure, either within the gauge or within the tube.

In order to verify accuracy of the gauge reading, the instrument was repeatedly compared with readings of a gauge attached normally to the tank. No perceptible difference in reading could be observed.

Two models of the instrument were developed, one having an open-work bronze reinforcement case for the plastic tubing (Sketch 8), the other with no reinforcement. Both models performed satisfactorily; the opinion prevailed, however, that the unit which had no reinforcing case would be more successful in field operations. There is little or no possibility of this unit's becoming bent or broken through rough handling, and furthermore, because it is continuously "washed" by solution in the tank it cannot collect insecticide or other material that would interfere with operation.

A TRICKLE VALVE THAT REGISTERS TWO DIFFERENT GAUGE PRESSURES

Most users of malaria control equipment now require a pressure regulator on their hand compression sprayers. By controlling pressure on the nozzle tip at a pre-set value, regardless of higher and continuously changing pressure within the tank, the regulator insures more uniform insecticide distribution, and consequently better residual spray application.

The question has always arisen of whether the pressure being delivered by the regulator varies during the discharge interval. Fairly frequent tests have been necessary to assure pressure uniformity. A means has now been developed whereby both tank pressure and nozzle tip pressure can be read directly from one gauge at approximately the same instant. This device has been named a "Trickle Valve." It is located within the pressure regulator.

The device is extremely simple in design and application and, since it weighs nothing, should cost almost nothing when applied to a new sprayer or to one already in use.

The trickle valve is made very simply. Within the pressure regulator are a valve and a valve seat; this valve regulates pressure through being opened a proper amount by spring pressure when the lance cut-off valve is opened. A properly functioning regulator valve always closes automatically when the cut-off valve is closed. To produce the desired effect of registering two different pressures at approximately the same instant, a very fine groove or channel is cut across the regulator valve seat with a fine three-cornered needle file. The groove must be just deep enough to permit the valve to leak slightly or "trickle" when it closes in response to the closure of the cut-off valve. The groove must not be very deep since the "trickle" must be low in volume (Sketch 6—Trickle Valve). Once the groove is cut and the valve reassembled, the apparatus is ready to function.

The next step is to attach the standard pressure gauge to or near the discharge (low pressure) orifice of the pressure regulator instead of in the conventional manner. It may be equipped with a modified sylphon tube, as described on page 195. Pressure is now generated in the tank cylinder and recorded as full pressure on the gauge. This happens because a small quantity of insecticide "trickles" past the regulator valve, thus generating full pressure at low volume in the discharge line.

As spraying proceeds, the cut-off valve is opened. Immediately pressure on the discharge line is adjusted by the regulator to the desired pre-set pressure and liquid flows at greatly increased volume; in fact, the trickle valve is by-passed. The nozzle tip pressure is now registered on the pressure gauge and can be adjusted as desired. When the cut-off valve is closed, after a lag of a second or two tank pressure is indicated; when the cut-off valve is opened to continue spraying, the nozzle tip pressure again is indicated on the gauge.

With such a device installed on a sprayer, the uncertainty regarding nozzle tip pressure is eliminated. The operator can always regulate tank pressure if some unforeseen variation takes place.

Quick Detachable (Bayonet Type) Attachment Discharge Line to Sprayer Tank

The type of quick detachable (Bayonet) attachment between discharge line and sprayer tank, often referred to as the "Q.D." attachment, has not been entirely satisfactory in the past. Attachment by this device was frequently more time-consuming than by the ordinary screw type coupling and furthermore the device was not always leakproof and repairs were not easily made.

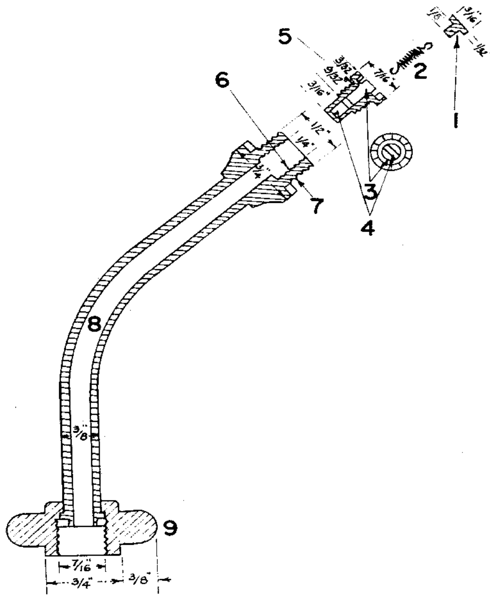
A correctly functioning, leakproof, quickly detachable coupling that seldom requires repairs is nevertheless a desirable accessory. Quick detachment of the discharge line not only makes for ease in cleaning but also increases transportation facility and convenience in handling and general equipment servicing.

When in operational position, particularly on hand compression sprayers, the unit should function to increase efficiency of the spraying operation. It should be flexible, allowing the discharge line assembly to turn freely through 360 degrees at the point where male and female coupling elements join. This freedom of movement is an asset in increasing uniform spraying efficiency. The unit so constructed may be called "The Swinging Discharge Line."

It is mandatory that no leakage occur at any time during operation or when joining or separating the male and female elements. As already indicated, the female element of the assembly must be a self-closing, rapidly acting, leakproof valve. It should be attached to the tank-to-dip tube coupling through a standard pipe thread (1/4-inch), and by as short a coupling assembly as possible. The valve within the Q.D. assembly retains pressure inside the sprayer tank even though the discharge line assembly is detached. No pressure is required to open this valve, opening taking place automatically when the male element is attached.

The male element normally consists of a short (1/2-inch) bayonet type coupling

NON-DRIP VALVE ASSEMBLY
(ON GOOSENECK)



DRAWN BY W.W MANN
PENNSYLVANIA STATE UNIVERSITY

1. VALVE
2. SPRING
3. SEAT
4. SPRING REST
5. SEAT (Male thread)
6. " (Female thread)
7. GOOSENECK (Male thread) ATTACHMENT TO NOZZLE-TI
8. GOOSENECK TUBE
9. FLEXIBLE COUPLING

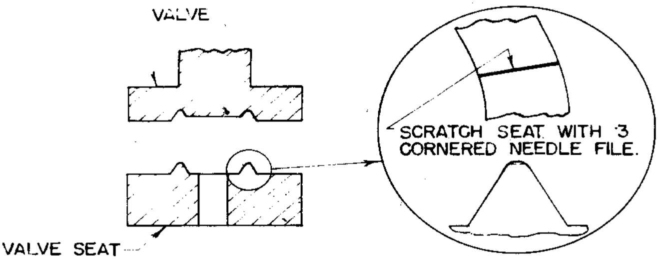
SKETCH 5
FRED W. KNIPE
ROCKEFELLER FOUNDA
FEB. 1958

which is introduced into the female element by light hand pressure. The various designs for holding the male and female elements together usually consist of properly interlocking metal rings. Heavy duty, non-corrosive springs of various types hold locking elements in place during operation. Discharge from the male element takes place through a shaped hose shank into the plastic discharge line.

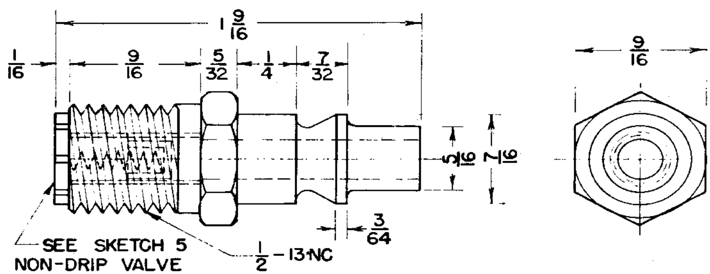
A commercial design for one type of Q.D. coupling[4] is shown in Sketch 7. This type of coupling is frequently used on high pressure compressed air lines but has been found equally satisfactory on the type of equipment under consideration. It is reasonably light in weight and has been hardened to withstand maximum field wear. The over-all length of the unit is approximately 2½ inches.

One essential modification is necessary to insure proper functioning of the unit, namely, the incorporation of a non-return or non-drip valve in the male element (Sketch 6—Q.D. Male Assembly). Unless this correction is made, insecticide within the discharge line will flow out through the detached open end of the element. The non-drip valve installed on experimental models was identical with the element used to prevent drip at the nozzle

[4] Manufactured by the ARO Equipment Corporation, Bryan, Ohio, USA, U. S. Patent No. 2,069,434.



TRICKLE VALVE



Q. D. MALE ASSEMBLY

SKETCH 6
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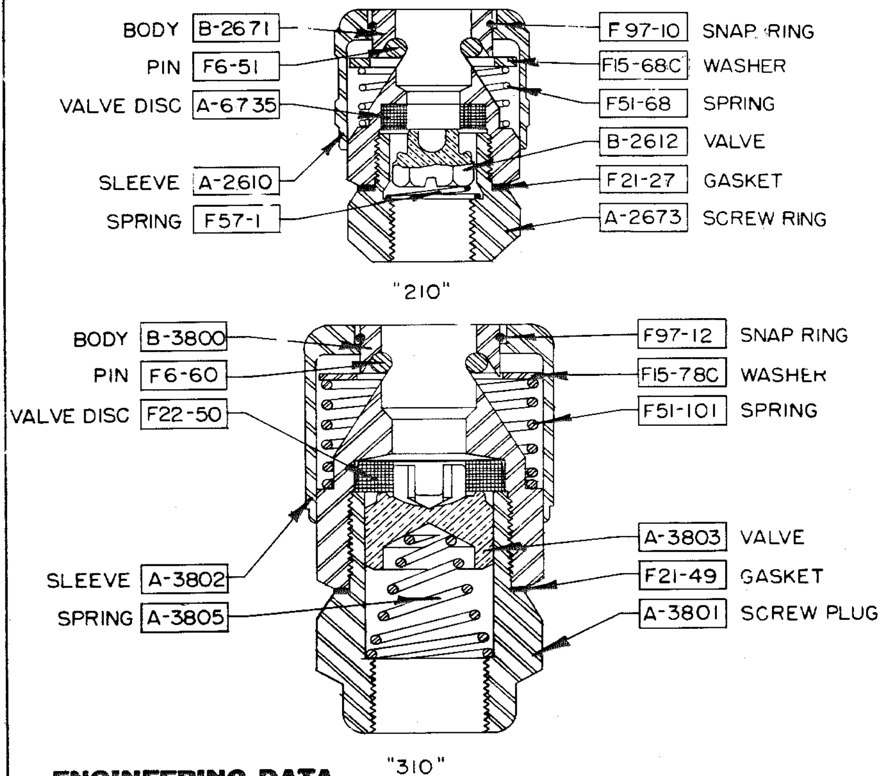
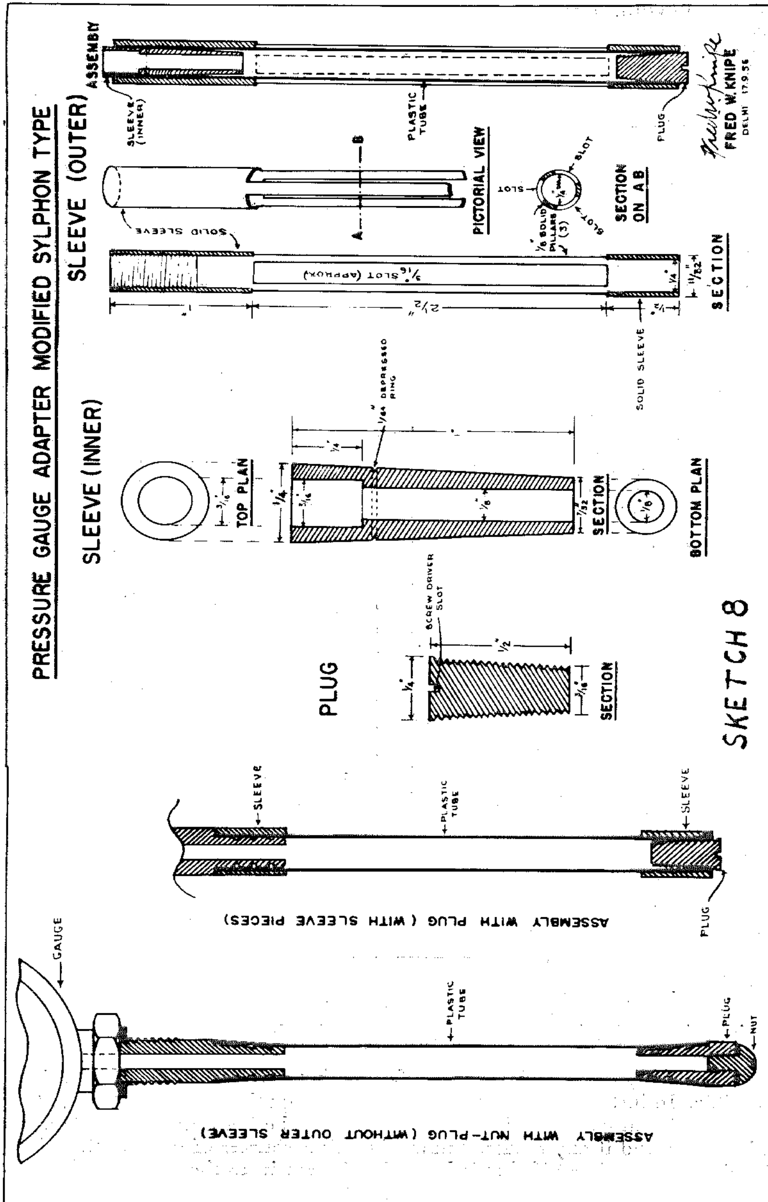


ENGINEERING DATA

1/4" & 3/8" SPEED COUPLER
MODELS 210 & 310

SKETCH 7


PRESSURE GAUGE ADAPTER MODIFIED SYLPHON TYPE
SLEEVE (OUTER)
ASSEMBLY
SLEEVE (INNER)
PLASTIC TUBE
PLUG
FRED W. KNIPE
DELHI 17.9.56
SOLID SLEEVE
PICTORIAL VIEW
SLOT
SECTION ON AB
1/8 SOLID PILLARS (3)
5/16 SLOT (APPROX)
SECTION
SOLID SLEEVE
1/64 DEPRESSED RING
TOP PLAN
SECTION
BOTTOM PLAN
SCREW DRIVER SLOT
PLUG
SECTION
SKETCH 8
SLEEVE
PLASTIC TUBE
SLEEVE
PLUG
ASSEMBLY WITH PLUG (WITH SLEEVE PIECES)
GAUGE
PLASTIC TUBE
PLUG
NUT
ASSEMBLY WITH NUT-PLUG (WITHOUT OUTER SLEEVE)

tip when the spraying operation has been interrupted.

The entire Q.D. attachment shown in the illustration is simple in construction, leakproof, light in weight, and practically foolproof in operation. It is unusually easy to attach and detach, requiring only slight pressure with one hand to connect. The female element is detached by depressing a spring-activated sliding sleeve, after which the male element is lifted away from the attachment control.

At this point further reference may be made to the non-drip (or non-return) valve mentioned above.

Commercial fabricators of sprayers have been inclined to equip this valve with a spring requiring far too much pressure to be opened. The result is an ultimate loss in tank working pressure, particularly noticeable with equipment functioning at a nozzle tip pressure of 10 p.s.i. Instances have been encountered where 5 p.s.i. pressure were required to open the non-drip valve and consequently, a minimum of 15 p.s.i. working pressure was needed in the tank to assure normal operation. Such an arrangement defeats the purpose of a constant operational tip pressure of 10 p.s.i. —or any other pressure. A low operational pressure of 10 p.s.i. has been established to conserve pumping labor, and if accessories are added which individually or collectively increase operational pressure above 10 p.s.i. (or any other chosen operational pressure), then repressurizing must take place more frequently.

Spring tension on the non-drip valve should be maintained at the lowest level that assures closure of the valve. When the valve is in repose, the pressure within the discharge line should automatically return to atmospheric pressure on the discharge side of the cut-off valve. Positive closure of the non-drip valve located in the male element is thus assured, even though pressure may remain higher between the female element of the Q.D. valve and the cut-off valve. An excellent example of a non-drip valve and the mode of installation is illustrated in Sketch 5.[5]

SUMMARY

Descriptions are given of several component parts of hand pressurized compression sprayers that have been redesigned or modified to improve over-all discharge efficiency. Every effort has been made to lower the cost of any changed or added element and to reduce over-all weight below the requirements of the World Health Organization.

References

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3. KNIPE, FRED W. 1957. Nozzle tip erosion resistance tests. Bull. Wld. Hlth. Org. 16:211–217.

4. KNIPE, FRED W. 1957. Pressure regulators and gauges on hand-compression sprayers: Some causes of failure and suggestions for improvement. Bull. Wld. Hlth. Org. 16:217–225.

[5] Designed and manufactured by American Spring and Pressing Co., Bombay (Madras), India.

Editor's Note: Although the work described in Mr. Knipe's paper refers especially to conditions in India, its world-wide applicability is obvious. Since probably the majority of subscribers to *Mosquito News* utilize United States sources of supplies, the editor asked Mr. Knipe to furnish names of manufacturers and suppliers in this country where possible. In instances where no United States supplier's name is given, Mr. Knipe knows of no such source for the item mentioned. All the items are clearly described and figured, however, and if any readers know of possible sources of supply other than those given, it will be appreciated if that information is sent in to the editor so that it can be published.