CHAPTER 4

SPRAYING EQUIPMENT

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LIST OF ILLUSTRATIONS

General

1. In order that spraying equipment can be used to the best advantage and without waste of effort, time and material, the correct type of equipment and the correct technique must be used. The equipment and material are listed in A.P.1086 and certain equipment, such as the pneumatic servicing trolley which supplies the pressure air is described in A.P.1464G, Vol. I, Part 2, Sect. 5. Chap. 12 and 13.

2. Spraying consists of atomising or breaking up a paint or dope stream into a spray by means of a spray gun which is the means of bringing compressed air and material together in the requisite proportions, according to the nature or viscosity of the material being used, and which ejects the spray and so deposits the paint or dope as a film on the surface to be covered.

3. There are numerous types of spray guns now in general use designed to meet the requirements of the Service and although they may differ in size and design, the fundamental principle is the same for all. An externally threaded connection for the reception of either the material hose or syphon cup is fixed under the body of the gun, and a further similar connection for the reception of the air pressure hose is provided under the grip.

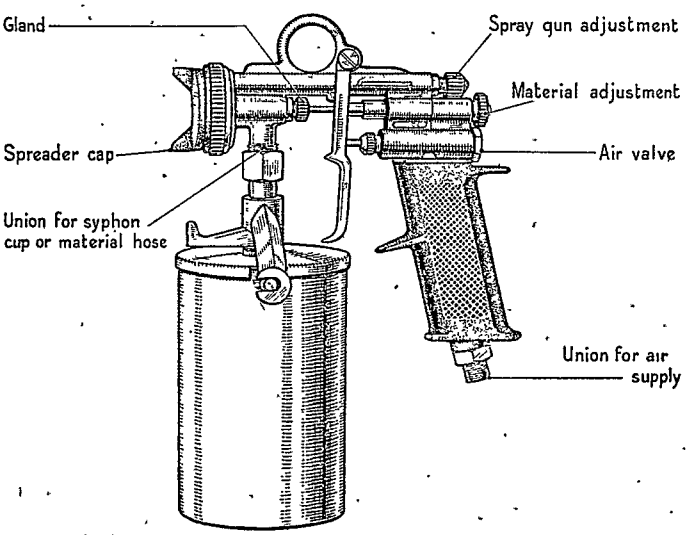

Fig 1.—Suction-feed type spray gun

4. Spray guns in the Service are capable of being fed (according to design) by either *suction* or *gravity* feed, when the gun is fed from a cup (see figs. 1 and 2) attached directly to the gun, or by *pressure* feed when the gun is fed with material through a hose from a separate pressure feed tank (see fig. 3) some distance away.

Suction feed and gravity feed

5. With the suction feed and gravity feed types, the spray gun is so designed that the compressed air, ejected through an annular orifice around the material nozzle, creates a small area of reduced air pressure or a state of partial vacuum at the fluid tip, which sucks out the fluid from a syphon or gravity cup attached to the gun. These types of feed are used where the area of the surface to be covered is small, such as when retouching, etc.

Pressure feed

6. With the pressure feed method (see fig. 3), a remote tank with a much larger capacity than the syphon cup is used, and the material is fed to the gun under pressure applied to the container whence it flows through a hose attached to the gun, the latter being adapted to take either the syphon cup or the hose end-fitting (see fig. 1). This method is used where the area to be covered is large, as it eliminates the necessity which would otherwise occur for constantly refilling the syphon cup with material. With a positive feed for the material, spraying can be speeded up and, in addition, the gun can be used in an inverted position.

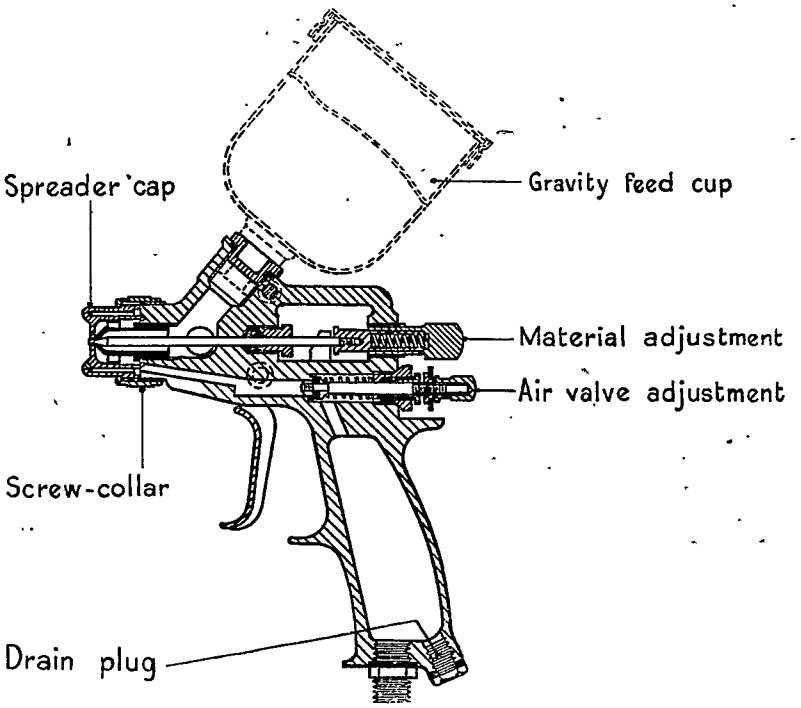

Fig. 2.—Gravity feed type spray gun

7. A combined air filter and pressure regulator, conveniently positioned in the air-line, extracts the oil and moisture from the compressed air.

The spray gun

8. Spray guns are designed to give a ready and easy control of spray pattern with varying spraying pressures and different materials without interrupting the spraying operation. The component parts of a general purpose gun such as is used in the Service is described in the following sub-paragraphs:—

(i) *The spray head.*—The spray head consists of a spreader cap which is screwed on to the nozzle at the ejecting end of the gun. The spreader cap is designed with two projections on the outer end face (see fig. 4) through which small air holes are drilled at an angle (spreader holes) so that when compressed air passes through them it converges towards the centre. In the centre of the cap is a larger hole into which the material nozzle projects leaving a small annular orifice around it through which air is ejected. The holes for both air and material may vary in size and number according to the type of gun.

gland and immediately behind the trigger. The air valve is opened by pulling the trigger and is closed by releasing it.

(vi) *Multiple jet spreader.*—A range of spreader caps with multiple jets for the better atomisation of the heavier bodied or more viscous materials are provided.

COMBINED AIR FILTER AND PRESSURE REGULATOR

9. In the process of compressing air, moisture and a certain amount of oil vapour from the compressor are liable to be carried into the air-line. To ensure that the air supply to the gun shall be clean and free from such vapour a filter is interposed between the air compressor and the gun or pressure tank.

10. The air filter and pressure regulator comprises a cylindrical metal container capable of withstanding a working pressure of 200 lb./sq. in. Enclosed in the cylinder are a stainless-steel ball-float and a lever pivoted to an arm on the valve housing and connected to the needle valve by a spring link. In its closed position, the valve is held on to its seat by the weight of the ball float and lever plus the working air pressure within. Water collecting in the trap raises the ball float, and compresses the valve spring till the coils are closed. When the buoyancy of the ball-float exceeds the pressure required to open the valve, the needle valve is snapped upwards from its seating by the action of the link spring under full compression. The water or collected moisture is then ejected from the trap until the level of the liquid is sufficiently low to enable the needle to re-seat and close the valve. This cycle is repeated automatically dependent on the rate of moisture collection in the trap. A gauze filter fitted to the needle-valve seat prevents the choking of the outside orifice by the entry of scale or dirt.

11. On some types, the filtration is effected by means of baffles and filter-pack whereby the moisture is extracted from the air passing through them. An air pressure regulator fitted to the air filter provides effective control of the air pressure at the gun. Gauges are fitted which indicate main line and regulated pressures, and valves provide outlets for pipe-lines to spray guns and other equipment. A drain cock is fixed at the lower end to allow the collected moisture to be periodically drained.

12. The air filter may, for convenience, be carried on the compressor unit trolley, but where possible it should be fitted as near as practicable to the spray gun or container and as remote as possible from the compressor, in order to reduce the possibility of condensation of moisture in the compressed air, at the gun end of the line, to a minimum.

Syphon cup

13. The syphon cup comprises a container which may be of one pint or one quart capacity and is provided with a quickly detachable lid which facilitates interchangeability from one cup to another when different colours are required, thus avoiding the necessity of cleaning the cup for each colour. The lid is provided with a union which screws on to the gun.

Pressure Feed Tank

14. A pressure feed tank (see fig. 3) consists of a steel container or tank which is heavily galvanised internally and externally. These pressure tanks hold the material to be sprayed and pressure air is delivered from the air compressor through a hose to the tank and through to the gun which is coupled by a hose to the tank. The material to be sprayed is thus forced out of the tank and delivered to the spray gun under pressure. The pressure tank provides a constant flow of material to the gun at a uniform pressure, and is normally supplied with a pressure regulator for the material-control, in which event the atomising air pressure will be controlled from the air filter and pressure regulator. An agitator for stirring the material is usually fitted. On the smaller types, the agitator is provided with a handle for turning by hand, but on the larger types the agitator is usually driven by a motor or a belt. A screw gland and packing around the shaft of the agitator prevents leakage of air. The tank cover is held down by quick-release clamping screws.

Functioning and adjustment of the spray gun

15. The air and material valves are controlled by the trigger which, when operated, opens the air valve slightly in advance of the material valve so that the air stream can atomise the fluid immeditately it emerges from the nozzle. Upon releasing the trigger, the material valve is closed slightly in advance of the air valve to ensure that all traces of material are blown from the nozzle. This effect is obtained by a clearance of approximately $\frac{1}{32}$ to $\frac{1}{16}$ in. allowed between the trigger and the end of the material valve. The various adjustments to the spray gun valves are described in the following sub-paragraphs:—

(i) *Adjusting flow of material.*—To adjust the flow of the material rotate the material adjusting valve (see fig. 4) in a *clockwise* direction to *decrease* the flow, and in an *anti-clockwise* direction to *increase* the flow.

(ii) *Regulating the air supply.*—To regulate the air supply to the spreader cap, screw-in the air adjustment valve in a *clockwise* direction to *reduce* the pressure, and in an *anti-clockwise* direction to *increase* the air supply. The air supply should be regulated with the trigger pulled back to its full extent.

(iii) *Valve glands.*—The material needle and the air valve spindle should be tightened up to prevent leakage which would cause intermittent spraying, but undue pressure must not be exerted—*finger tight* only—otherwise the needle and spindle will bind. The material nozzle, air valve body, spray head collar and union nuts, must be screwed home *tightly* and when using a container attached to the gun it should be ensured that the cover makes an air-tight joint otherwise intermittent spraying will result.

(iv) *Clearing air holes.*—The vent hole in the syphon cup must be kept clear to allow the air to take up the displacement of material. The holes in the spray head should also be kept clear, as the presence of foreign matter will affect the shape of the spray pattern. Do not attempt to clear obstructions from the air holes or vent hole by means of a hard implement, such as a wire or nail, or the holes may become enlarged or damaged; a pipe cleaner, a piece of thin soft wood or a broom bristle should be used instead.

(v) *Oiling.*—The fluid needle, air valve spindle and trigger-bearing screw require lubricating daily (see fig. 4). The material needle gland should be unscrewed occasionally and the packing softened with oil. The needle spring should be coated with light grease.

Adjustment of fluid and air pressure (with pressure feed tank)

16. The adjustments on the gun for the flow of material and the air pressure to the spreader cap have been described already in para. 15 (i), (ii). In adjustments for the material pressure there are two factors to consider, namely, the pressure maintained in the tank (material) and the size of the nozzle being used. There is no definite formula for determining how much pressure shall be maintained in the tank, as the requisite pressure varies with the viscosity of the material, the speed capacity of the gun, and the required thickness of film deposit. But, whatever the nature of the work in hand or the materials being used, the trigger should be regulated so that it is pulled back to its full extent in use. By this adjustment the results are more constant and the effort less fatiguing for the operator. For a general method of setting the equipment for average work and conditions, proceed in the following manner:—

(i) Set the material adjustment screw so that the first thread is exposed when the trigger is pulled back to its full extent. This setting brings the needle clear of the nozzle, thus ensuring a good spray pattern that might be distorted if operated with a restricted flow of material at the nozzle.

(ii) Set the atomising air pressure fairly low, say 35–40 lb. pressure and, commencing with no pressure in the container, adjust and increase the pressure until the desired amount of material is obtained for the work being sprayed and the speed of the operator. If too much material flows with less than 5 lb. pressure in the container, then it is advisable to fit a smaller sized material nozzle and needle.

(iii) When the required material flow has been obtained, adjust the atomising air pressure to the lowest possible pressure that will give the correct atomisation of the material being used.

(iv) If the work requires several overlaps and there is a possiblity of runs or sags forming, the atomising air only should be increased; this will dry out some of the solvent and the material will reach the surface in a drier state.

Preparing for operation

17. Before using dope or paint, *stir well and thoroughly mix* the contents in the container. The same care must be taken whether for brushing or spraying. The dope or paint should be strained if it contains any small lumps or skin. Before using any material pour a small quantity of thinners into the cup for testing purposes. If the spray is intermittent or the atomised stream irregular it may be caused by a loose union or connection. The air filter should be drained daily or more often if the atmosphere is humid by opening the drain cock fitted at the bottom of the filter. Check over all adjustments as indicated in paras. 22 and 23.

18. Always use the lowest pressure necessary to give good atomisation; an atomising pressure of within the range of 35 to 60 lb./sq. in. will be found sufficient to cover practically all materials in conjunction with a pressure of 5–10 lb./sq. in. in the pressure feed tank.

19. For testing the effects of adjustments made to the air and the material controls, especially with a new type of gun, an excellent method is to use water to acquire familiarity in the use of the gun and controls, as water causes no disfigurement of the surface sprayed, can be quickly wiped off and tends to clean the gun and avoids waste of material.

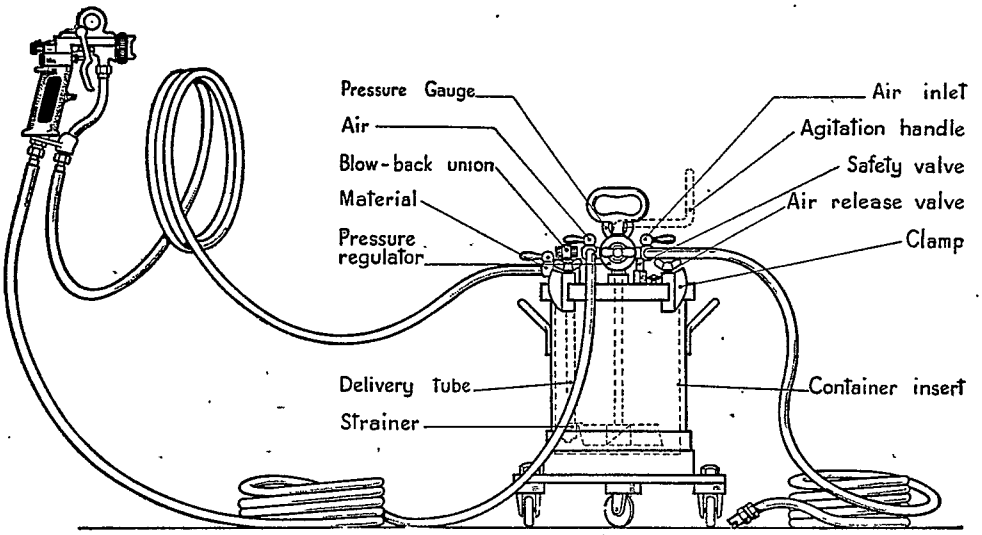

Fig. 3.—Pressure feed system

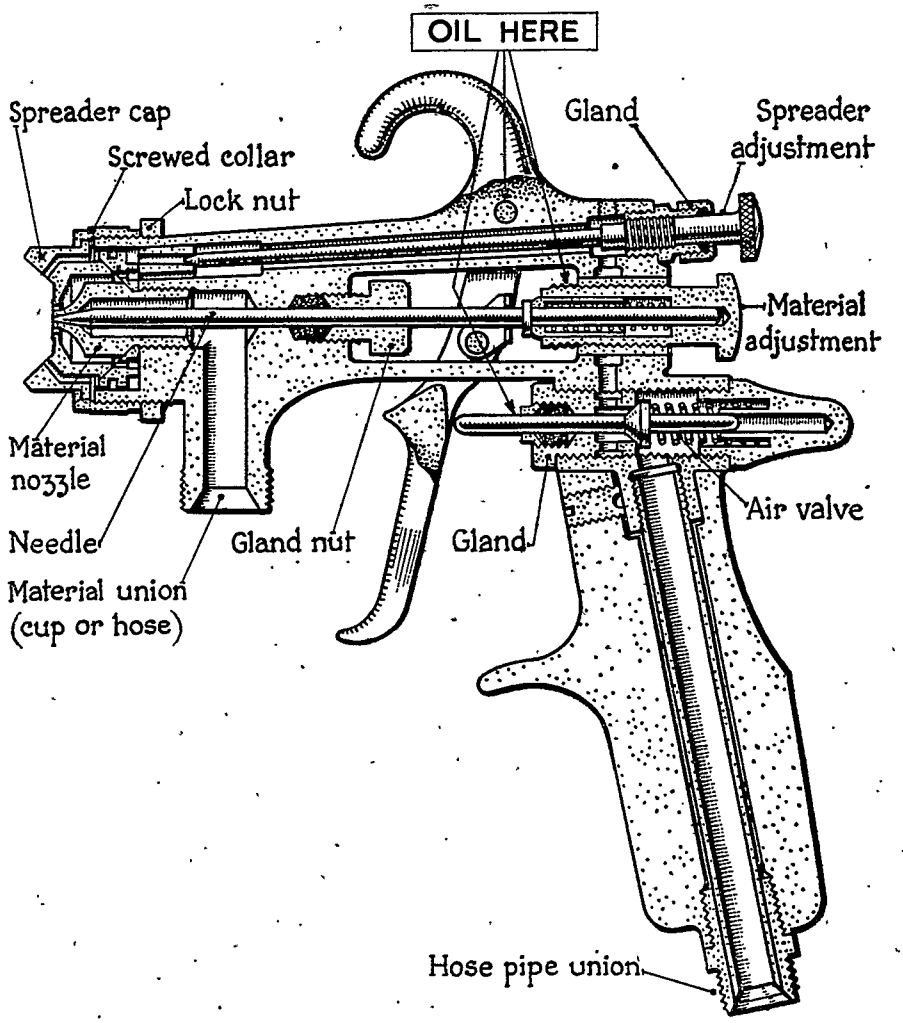

Fig. 4.—Sectional view of spray gun

(ii) *Material nozzle.*—The material nozzle consists of a sleeve jet made of hardened stainless steel with an orifice through its centre, through which the material is drawn or ejected. One end of the material nozzle is screw-threaded and fits into the gun body and, when the spreader cap is screwed into position the material nozzle is situated centrally in the centre hole of the spreader cap, as already stated, leaving a small annular air orifice around the tip and an air space between the conically-shaped body of the nozzle and the inner surface of the cap. At the inner end of the orifice in the material nozzle a seat is provided for the material needle and, by the adjustment of this needle, the material is metered through the nozzle as required.

(iii) *The material needle valve.*—The material needle valve comprises a spring-loaded needle of hardened stainless steel, one end of which is ground to a point, a knurled head being fixed at the opposite end for adjustment purposes. The needle point seats in the inner side of the hole in the material nozzle, thus controlling the flow of the material. The needle extends the whole length of the gun body, passing through a gland where it is fitted with a sleeve which is a sliding fit in the hollow adjusting screw, the head of which projects from the gun body; between the screw and needle sleeve is a coil spring. The sleeve has a collar which engages with the trigger for control purposes.

(iv) *The spreader cap adjustment.*—The spreader cap adjustment on certain types of gun consists of a spring-loaded needle valve, ground at one end for a seat in the air duct, passing through a gland and fitted at its opposite end with a head which projects at the rear end of the gun immediately above the material valve. This valve controls the air to the holes in the spreader cap, enabling adjustments to be made to obtain a desired pattern, varying from round to elongated patterns of different widths. In other types of spray gun, adjustment is made by rotating the spreader cap in a clockwise direction, when the valve gradually closes the air duct leading to the spreader holes so that air is being ejected only through the annular orifice around the fluid tip. In this position the spray issuing from the gun is truly conical and forms a round pattern varying in diameter according to the distance that the nozzle is held from the surface being sprayed. The nearer the gun is held to the surface the smaller the pattern and the thicker the film deposited; conversely, the further away the gun is held the larger the pattern and the thinner the film deposited. By rotating the spreader cap in the opposite direction, the air ducts to the spreader holes are gradually opened. The air being ejected from these holes converges into the central atomised stream and so causes elongation of the pattern, and the more the valve is opened the more elongated the pattern becomes as a result of the additional influence of the increased air stream converging on the central stream. For a horizontal elongation of the pattern the spreader holes on the cap will be vertical (see fig. 5). For a vertically elongated pattern the holes will be in a horizontal plane.

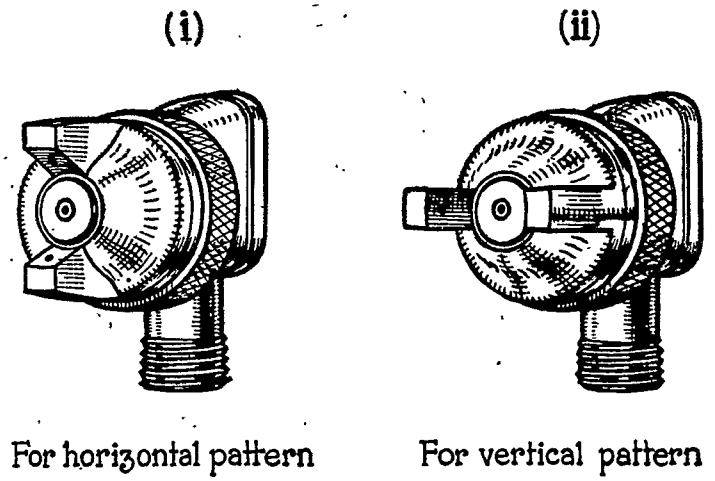

Fig. 5.—Nozzle setting for spray pattern

(v) *The air valve.*—The air valve consists of a spindle to one end of which a collar is fitted to take the thrust of the valve return-spring; the other side of the collar is ground at a suitable angle to form an air-tight seat in the air-valve body. Around the spindle is a gland and packing to prevent air leakage. The air-valve body is screwed into the gun body and is positioned behind the trigger below its fulcrum point with the head of the air valve immediately below the fluid valve, the opposite end of the spindle protruding from the

20. To test for correct atomisation of material, spray a pane of clear glass. This will reveal very clearly any imperfections of the spray pattern that may otherwise escape detection. The material should be wiped off the glass at each test before it dries.

Cleaning (syphon cup type)

21. Immediately after use, remove the material from the syphon cup—pour on a small quantity of cleaning solvent and replace the cup on the gun. Spray the solvent through the gun whilst holding a piece of rag alternately against and away from the nozzle. This forces the thinners back and forth through the ducts. Then clean out the cup. Alternatively, remove the cup or the material hose from the spray gun connection—whichever has been used—turn the gun upside down and pour the solvent down the material orifice (see fig. 6), in the meanwhile operating the trigger repeatedly to flush the ducts and clean the tip of the needle.

Note.—The solvent used in cleaning will be Brushwash cleaning liquid 33B/140 after using "C" type material, while for "S" materials primer thinner 33B/510 should be used.

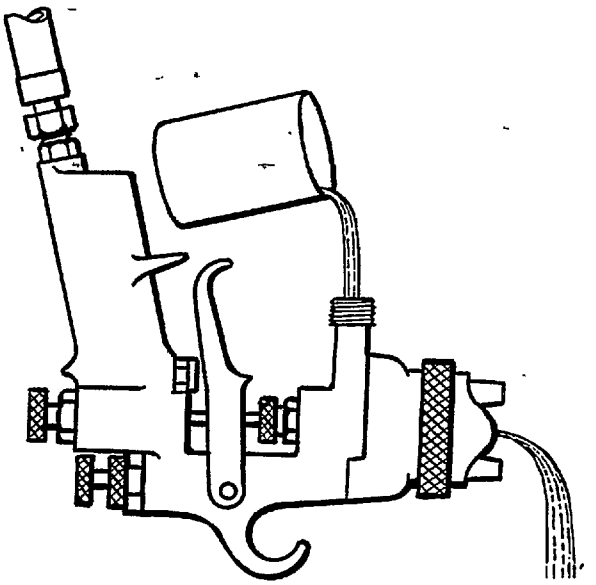

Fig. 6.—Flushing material ducts and nozzle

Cleaning (Pressure feed tank type)

22. When the pressure feed tank has been used, release the pressure in the tank by opening the relief valve mounted on the cover of the tank, then loosen the clamps which hold the cover in position. Hold a piece of rag over the holes in the air cap and pull the trigger. This forces the material in the gun and hose back into the container. Then remove the insert containing the material and replace with one into which the cleaning solvent has been poured. Replace the cover, close the relief valve and connect up the hoses as for spraying. Now spray the solvent through the gun which will clean the material hose and the gun.

23. On certain types of pressure tank a "blow back" union is provided to facilitate cleaning the hose. This consists of a two-way adaptor secured to the cover of the tank. To clean the hose proceed as follows:—

(i) Turn off all the cocks and release the air pressure from the tank.

(ii) Disconnect the material hose from the gun and couple to the respective union on the two-way adaptor.

(iii) Disconnect the air supply hose from the air inlet connection and couple to the other union on the two-way adaptor.

(iv) Open the fluid cock and turn on the air from the compressor; the air pressure will then force the material in the hose back into the container.

(v) To clean the hose and the gun with solvent proceed as described below.

Cleaning the spray gun

24. It may not be possible to clean the spray gun by the method already described in para. 21 and it will be necessary to remove the spreader cap and material nozzle if the material has at any time been allowed to dry in the gun. It may however be possible to avoid any dismantling if the nose of the gun is immersed for some time in a shallow tray of thinners or dope solvent. The gun should not be completely submerged, otherwise the packings will be dried out (see fig. 7).

25. If it should happen that the gun is left for two or three hours without cleaning, remove the material and replace with a small quantity of thinners, then hang the gun up on a wall bracket; the material will not then harden and it will be possible to clean the gun by spraying some of the thinners through it whilst repeatedly covering the air holes in the nozzle by applying the finger or a piece of rag intermittently.

Gland packing

26. The gland nuts should be unscrewed when no further adjustment is possible; the old packing should be removed and replaced by a three or four inch length of graphited asbestos string coiled round the respective needle. The gland nut should only be screwed up finger-tight, as excessive pressure will cause the needle to bind.

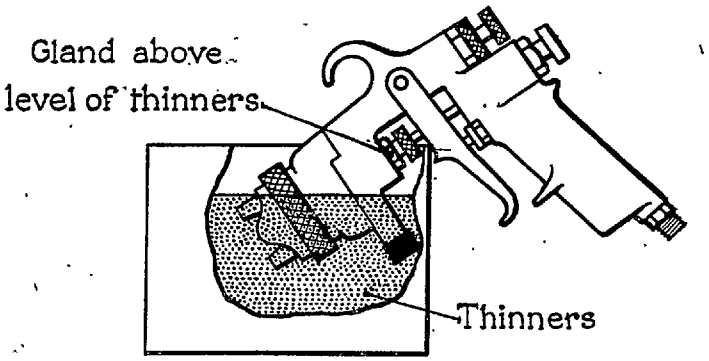

Fig. 7.—Immersion of spray gun head for cleaning

Removal of needle valves

27. The needle valves on normal types of spray gun can usually be removed after first unscrewing the adjusting screw and removing the spring. It may be necessary to slacken the gland nut if the needle is at all worn by use. Before replacing the needle in position it should be cleaned and lightly smeared with light grease.

Removal of material nozzle

28. The material nozzle is generally screwed into the gun body and is accessible, after the spreader cap has been removed, by unscrewing its collar or sleeve nut. Only the special ring spanner should be used when unscrewing or tightening the nozzle. Numbers or letters on the nozzle, spreader cap and needle indicate the relative sizes of each, according to the type of gun to which they are fitted.

Air hose

29. The air hose to the spray gun should be kept in good condition and should be supported as near to the gun as possible to relieve the operator of its weight and yet allow full and free movement. The hose should not be trodden under foot or run over by trolleys, etc. If any difficulty is experienced in obtaining good atomisation the size of the hose may be too small for the gun; it has been found that with a 25 ft. length of $\frac{1}{4}$ in. hose there is a pressure drop at the gun of 16 lb./sq. in., while for a similar length of $\frac{5}{16}$ in. hose there is a drop of only 5 lb./sq. in. The pressure should be checked at the gun by means of a suitable pressure gauge whilst the trigger is pulled.

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