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INSTRUCTIONS

26
Manuals
2855

FOR THE

OPERATION AND MAINTENANCE

OF

DISINFECTORS, PORTABLE, FIELD, Nos. 1, 2, and 3

1941

By Command of the Army Council,

I. J. G. J.

THE WAR OFFICE,
31st October, 1941.

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FOR THE

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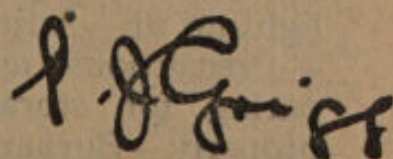
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CHAPTER I.

INTRODUCTORY.

PORTABLE STEAM DISINFECTION APPARATUS
IN THE FIELD.

The destruction of lice and other parasites and their eggs, and of disease bacteria, may be carried out either by a flow of steam at virtually atmospheric pressure ("current" steam), or by stationary steam at a pressure of 15/20 lb. per square inch ("pressure" or "static" steam). Each method has certain advantages. For field use, however, "current" steam has the great benefits of needing only simple light-weight apparatus and of lending itself readily to improvisation in ways which are described in the Manual. In consequence, steam disinfection in the field is done by the "current" steam process.

Whether current or pressure steam is used, the most important point is the complete evacuation of air from the articles treated, so that every single part of every article is permeated by steam. Air is a very bad conductor of heat and any pockets of air which are left in the charge will prevent those parts from reaching anything like the disinfecting temperature of 100° C. As a result, blankets, clothing, etc., which still carry infection, may be passed out to store or used in contact with clean articles, and so spread the infection wider instead of stamping it out.

In pressure steam disinfectors the air is usually extracted by an "ejector" worked at about 60 lb. per square inch pressure, which is a matter of considerable difficulty and no great reliability. In current steam disinfectors the air is not *extracted* but *displaced*, advantage being taken of the fact that it is denser (heavier per cubic foot) than steam. The process is known as the "downward displacement of air," and, provided that certain simple rules are observed, can be made both more rapid and more certain than the extraction process. It is carried out by admitting steam to the top of a closed container, in which the articles are placed, and which has an exhaust vent at the bottom. The steam, gathering above the charge, displaces the colder heavier air downwards, and urges it steadily out of the exhaust vent until, after all the air has gone, steam only will issue in a constant flow. Steam admission is continued for a short time after apparent displacement of all the air to make quite sure that disinfection is complete before the supply is cut off and the container opened up for unloading.

Ideally, therefore, the steam should act as a gentle flat piston (which, for example, takes about 10 minutes to reach the bottom of the container in the D.P.F. No. 3), but in fact this ideal is not reached. The resistance to steam flow will not be *absolutely* equal over the whole area of the container, and steam will reach the bottom and escape, somewhat earlier through one part of the charge than through another. For a minute or two before evacuation is complete, therefore, steam and air will probably be escaping through the exhaust pipe in alternate gushes. Disinfection cannot be considered to be complete until it is quite certain that every last cubic inch of air has gone, which will normally be revealed by three or four minutes of unbroken steam exhaust at full bore.

Now it is obvious that if the articles are packed in the container all over to one side, leaving a gap down the other side, then the flat piston effect will not be obtained. The steam will pass down the opening left for it, along the bottom to the exhaust vent, and out through the pipe. As a result a pocket of air will be trapped inside the charge. An unwary operator, seeing the steam issuing full blast would think that all was well. A wary operator, noting that the steam issued at full blast *far too soon* would realize that air displacement was incomplete. This visual indication of correct working is a very valuable feature of current steam disinfectors, and has no counterpart in the pressure type.

The example given is not so improbable as it sounds. Disinfectors Nos. 2 and 3 have containers dimensioned to fit folded blankets, but blankets may vary in size. If the blankets are a few inches short or narrow and are neatly folded, they will *not* fit the container, and the gap described, even though it may be only half an inch or so, will exist and the steam will take advantage of it. In such a case the bales of blankets must be pressed against one side and end of the container by separate blankets thrust all the way down the gaps at the other side and end. The loose blankets will, of course, be as completely disinfected as the baled ones.

A similar effect can sometimes be obtained by bad packing, which is not obvious to the eye. If the charge is so loaded as to leave an air space underneath, as when a bale of blankets is put in askew and not pressed down evenly on the bottom, some air may be trapped by the steam flow and incomplete disinfection result. Air *above* the charge does not matter. The D.P.F. No. 3 has been tested with a load of only seven blankets, so that air occupied more than 4/5ths of the container volume; but the loading having been properly done, disinfection was perfect.

It follows that articles, such as clothing or equipment, which

cannot be folded to container-size, must be so loaded and packed with blankets, as to give an even or nearly even resistance to steam flow over the whole area. The packing should be firm, without internal air-spaces. A very little experience, with study of the notes which are given later, will enable an intelligent man to judge the most efficient way of packing the various articles dealt with.

In the case of the steam-jacketed disinfectors, the only steam to escape from the exhaust pipe in the first few minutes (4-5 minutes for the No. 2, 8-10 minutes for the No. 3) of disinfection, should be the small amount evaporated from the blankets adjacent to the hot surfaces at the bottom of the container. During this time, air, warmed by the jacketing and by the hot exhaust pipe, is escaping, and may be felt by placing the hand before the end of the pipe. Next, steam which has passed through the charge will issue and rapidly grow in volume, its flow being usually intermittently interrupted by the remnants of the contained air. Finally, after roughly 7 minutes with the No. 2 or 12-15 minutes with the No. 3, the steam exhaust will have reached its full volume without interruption by air. It is so continued for a few minutes, after which the operation is complete.

In the case of the No. 1, which is not steam-jacketed, the first emission of steam will be of that which has passed through the charge (15 minutes or so), after which the progress is as above.

The times given above are only approximate. Naturally they will vary with the nature and volume of the load, the coldness of the weather, and the efficiency of the burner, the latter two factors affecting the rate of generation of steam in the boiler. The three stages of exhaust—air only, air and steam alternately, steam only—must, however, be watched and roughly timed for every charge, for disinfection is never a process to be lightly regarded. If steam issues in quantity much too soon, do not take a chance. Shut off steam, open up, re-pack and try again.

It must not be imagined from the above that the Service disinfectors are unreliable or difficult to use. Simple as they are, they are more uniformly effective than any other steam disinfectors yet tested.

The field steam disinfectors are three in number. The D.P.F. No. 1, which is carried on a special 3-ton drop-sided lorry, has cylindrical containers, mounted on trunnions, which are used alternately. The cylindrical shape is convenient for the disinfection of mattresses. The containers are loaded in

the inclined position and then rotated for connection to the steam supply. The "up-ending" consolidates the charge to the bottom and sides of the container, and is a useful feature of the design.

This disinfector has, for war-time provision, been superseded by the D.P.F. No. 3, which is lighter, smaller, cheaper and easier to manufacture.

The D.P.F. No. 3 is intended primarily for blankets, clothing and "biscuits," although it can with careful packing be used to disinfect small numbers of mattresses. It has fixed containers of rectangular section which are jacketed by steam, and are loaded and unloaded from the top. The containers are steamed simultaneously, except when loading or unloading, when one is steamed and the other opened up. It may be mounted on any vehicle from the 15-cwt. personnel-carrier upwards. When mounted on a 15-cwt. personnel-carrier, however, the hood framing must be raised and the half-drop-sides supported on swing brackets, to form an operating platform. At present (July, 1941) it is carried on vehicles provided for the D.P.F. No. 1.

The D.P.F. No. 2 is a small light-weight disinfector for pack transport, with a steam-jacketed container of rectangular section.

All three disinfectors have a high rate of output. The Nos. 1 and 3, in fact, are limited more by the capacity of the working party to handle the output than by their rate of disinfection.

Detailed instructions for the operation and maintenance of each disinfector follow.

A complete list of parts is not included in this handbook, owing to the difficulties created when amendments to details are made. The parts lists are published separately, as stated below. A copy of the parts lists is issued with each disinfector, and amendment slips are circulated or issued to holders of the lists. In cases where issue of disinfectors is made before parts lists are ready, an A.C.I. may be expected to be issued, advising when parts lists are available to be demanded.

C.I.E.S.S. Part List No. E.S. 127—

Consisting of C.I.E.S.S. Part List No. 196 for Disinfector, Portable Field, No. 1; and

C.I.E.S.S. Part List No. 197, for Burner, Oil, No. 1; and

C.I.E.S.S. Part List No. 200, for Burner Unit, Hydra, S.B., Type E.

C.I.E.S.S. Part List No. E.S. 61—

Consisting of C.I.E.S.S. Part List No. 199, for Disinfector, Portable, Field, No. 2; and

C.I.E.S.S. Part List No. 200, for Burner Unit, Hydra, S.B., Type E.

C.I.E.S.S. Part List No. E.S. 62—

Consisting of C.I.E.S.S. Part List No. 198, for Disinfector, Portable, Field, No. 3; and

C.I.E.S.S. Part List No. 200, for Burner Unit, Hydra, S.B., Type E.

CHAPTER II.

DISINFECTOR, PORTABLE, FIELD, No. 1.

1. General description. (*See Plate 1.*)

The disinfector is of the downward-displacement current-steam type. It consists of a cylindrical boiler mounted between two rotatable cylindrical containers. Steam rises from the boiler space through a $1\frac{1}{2}$ -inch steel pipe uptake to a three-way cock.

One outlet of the cock is connected to a flexible rubber hose, which has an "instantaneous" (fire-hose pattern) swivel coupling at each end. This type of joint enables the hose to be swung round to connect to either of the two containers. The hose is supported by a bracket pivoting on the steam up-take from the boiler. The other outlet from the three-way valve is permanently connected to the flue-pipe for exhausting steam when not required for disinfection.

Each container is mounted on trunnions on its own stand. It is provided with means of holding it firmly in inclined, horizontal and vertical positions. The boiler is separate, so the disinfector comprises three independent parts, two of which are identical.

The steam hose and boiler are asbestos-lagged. The containers are also heat-insulated, but in a different manner.

Each container has a loose lid, held on by four clamps, which has a hole in the centre. The lid fits on to the opposite end of the container from that at which steam is admitted, *i.e.*, when

steaming the lid is at the bottom. The steam inlet end of the container carries the female half of the "instantaneous" coupling to receive the flexible hose.

The operation of the disinfector is as follows:—while steam is being raised, one container is swung into a vertical or inclined position, lid end uppermost. The lid is removed, and the articles to be treated are packed inside. The lid is then clamped on, and the container rotated into the vertical position, with lid downwards. The steam hose is now connected up, and when steam is available it is turned on at the three-way cock, which until now has been open to the flue pipe. While disinfection is proceeding the other container is similarly loaded. When disinfection in the first container is complete, the three-way cock is set to pass steam to the flue-pipe while the flexible hose is disconnected, swung round, and connected up to the second container. The three-way cock is then set to pass the steam to the second container.

The first container is then rotated over to the opposite side of the vehicle from that on which it was loaded, the contents taken out, shaken and disposed of. It is then rotated over to the loading side and re-loaded ready for steaming again.

Disinfection so proceeds alternately in the two containers until the task is completed.

2. Operating party required.

No. 1.—In charge. Supervises disinfection, gives orders to Nos. 2 and 3. Commands "Clean" side working party.

No. 2.—Commands "Dirty" side working party. Loads the disinfector, connects and disconnects flexible hose.

No. 3.—Attends to boiler and burner and operates 3-way valve.

3. Working party required.

A party to prepare and pass articles for disinfection up to No. 2 will be required on the "dirty" side.

A party to unload, shake out, re-fold or roll, and stack disinfected articles will be required on the "clean" side.

The size of the parties will depend on the nature and quantity of articles to be disinfected. The output of blankets is around 150 per hour, and this will require, say, four men on the "dirty" side and six men on the "clean" side for continuous working.

There should be no passage of persons between "dirty" and "clean" sides, and the only passage of articles should be through the disinfection process.

4. Filling the boiler.

The boiler is filled through the funnel-topped 1-inch pipe. This pipe also acts as a low-water alarm. When steam issues from it, water level is too low. A whistle is plugged into the top to attract attention to the issuing of steam.

To fill the boiler, open the levelling cock and unplug the steam whistle. Fill till the levelling cock overflows. Close cock and replace whistle.

Add make-up water at the end of each disinfection cycle, *i.e.*, when changing over the flexible hose. Water consumption is 8-10 gallons per hour. The initial filling is sufficient for 1½ hours' steaming without make-up.

5. The burner. (See Plate 6.)

The burner hitherto issued is Burner, Oil, No. 1; previously it was widely known as the Rutherford Type W.3 Burner, which, however, is supplied in different forms for different purposes. Instructions for the Burner, Oil, No. 1, follow separately.

Two Burner Units, Hydra, S.B., Type E (Plate 5), as used for the Disinfector, Portable, Field, No. 3, may in future be issued for the Disinfector, Portable, Field, No. 1, in place of one Burner, Oil, No. 1. The Hydra Burner will need special packing to the correct height for the boiler fire-tube.

6. Disinfection.

(a) *Preparation of articles.*—(i) Provide suitable ground covering to protect articles from dirt and damp. Collect articles for disinfection on the "dirty" side clear of the vehicle.

(ii) Articles should not be folded or rolled; they should be packed more or less "as they come," except mattresses.

(b) *Loading the container.*—Lay the lid down carefully. Do not bang its edge on the lorry floor. Spread an old blanket over the inside of the container end on which to start packing. Put the blankets, clothing, etc., on the blanket and load up, pushing them into position with a stick until within reach. Pack reasonably evenly, without leaving any easy passages for steam. Cover the top of the load with an old blanket, and then replace and clamp down the lid. Swing the container into the steaming position.

Although the container will easily hold three mattresses, NOT MORE THAN TWO should be put in one container at the one time. Roll the two mattresses one round the other, and hold them tight by rolling the bundle inside blankets to

ensure that no part of the mattresses comes into contact with the container wall. At least four blankets should be spread over the bottom of the container before loading the mattress bundle, and the remaining space filled with blankets in the way described for the disinfection of loads of blankets. After unloading, men should stand aside each mattress placed on edge, and pat the two sides vigorously until all evidence of steam has disappeared.

The container is provided with a catch for holding it securely in inclined, vertical or horizontal positions. Use it, or the container may swing over on its own and knock men off the lorry.

(c) *Steaming*.—With the loaded container vertical, lid end downwards, connect up the steam hose and turn on steam at the three-way cock. With a full load, after about 15 minutes, steam will start issuing through the central hole in the lid, and possibly at the edges also. At first only wisps of steam issue, but in a minute or two these increase to full volume. Take the time from the beginning of full volume and steam for five minutes. Then switch the steam over to the flue-pipe, disconnect the flexible hose, swing it round, and re-connect it to the other container (if loaded and ready), and start steaming the second container.

(d) *Unloading and shaking*.—Swing the disconnected container over to the "clean" side, fix it in the inclined position with lid uppermost, remove lid and *gently* lay it down or stand it clear of operations. Wearing gloves, unload the hot articles singly and pass them to the working party. The latter, working normally in pairs, take the article and shake it *vigorously* to clear it of contained steam. Blankets must be held by the four corners. At least eight hard up-and-down shakes are necessary. Then fold, roll or stack articles for removal, or, if weather is suitable, air on a line for up to half an hour. Keep them clear of dirt, damp or untreated articles.

If these instructions are followed, articles after disinfection are practically as dry as before. If not, the contained steam will condense to water, will be absorbed, and will leave the articles thoroughly damp.

Unload only as fast as the working party can dispose of the articles, but keep the job moving briskly. In the final stages of unloading it will be more convenient to have the container horizontal.

7. Maintenance.

The apparatus is simple, and no trouble will arise if it is handled with reasonable intelligence. Leakage of steam

round the edges of the lid is not material. Small steam leaks at other points are not detrimental to disinfection, except in the extent to which they reduce the volume of steam passing through the container. They will, however, cause rust, and may injure persons, and should be corrected at once.

All parts are interchangeable, and replacements may be demanded from D.A.D.O.S. Worn out or defective parts must be handed in for salvage.

Some boilers of early design are made without facilities for removing fire-tubes for de-scaling. Others should be de-scaled at regular intervals.

The boiler should be emptied on closing down, unless it is intended to fire again within 24 hours, or water is scarce.

Before storage, see that containers and lids are dry inside and the boiler empty.

Note the precautions against frost, detailed in the burner instructions, which have to be taken to prevent damage to the burner.

8. General notes on quantities.

Boiler holds about 35 gallons.

Water consumption is 8-10 gallons per hour.

Available water (difference between full level and level at which steam blows), about 15 gallons.

Burner uses about 1 gallon of fuel per hour.

Steam is raised from cold in 45 minutes.

Output in blankets about 150 per hour.

9. Weights.

Variation in detail of manufacture and simplifications in construction which have been introduced from time to time make it impossible to give accurate weights of components. Rough weights are :—

Container and lid		460 lb.
Container stand		210 lb.
Boiler (empty)		450 lb.
Pipes and fittings		60 lb.
Burner, complete		100 lb.
Disinfector, complete (boiler empty)		2,000 lb. or say 18 cwts.
Disinfector, complete (boiler full)		2,350 lb. or say 21 cwts.

10. List of parts comprising complete outfit.

Disinfector, complete with 2 containers.

Container stands; holding-down bolts and nuts; boiler with flue-pipe, steam uptake, hose bracket, three-way cock, filling pipe and steam whistle; flexible rubber steam hose, asbestos and canvas covered; wooden platform to fit over boiler.

*Burner, Oil, No. 1, on stand with telescopic legs, with kit of tools, pump, a few spares, and an instruction booklet.

Pails, iron, galvanized, 3-gallon—2.

Gauntlets, leather, gloves, hedging, or equivalent—pairs 2.

CHAPTER III.

DISINFECTOR, PORTABLE, FIELD, No. 2.

1. General description. (See Plates 2 and 4.)

The disinfector consists of an outer casing in which steam is raised, with an inner container in which articles are disinfected, with a narrow steam space between the two. The lid fits on to the top edges of the outer casing with a steam-tight fit, leaving a $1\frac{1}{2}$ -inch space between the underside of the lid and the top edges of the inner container. Steam rising from the boiling water surrounds the outside of the container, passes over its top edges, down through the charge, and out to atmosphere through a $\frac{3}{4}$ -inch pipe welded to the container bottom.

The outer casing is fitted with carrying handles at the ends, and with D-rings for hooking on to a pack-saddle on one side. It has a welded-on funnel which also acts as low-water alarm and safety-valve, and a $\frac{1}{4}$ -inch pet-cock to indicate full-water level. Its bottom is arched to tunnel-form, enabling the disinfector to be heated either over a trench-fire, or by a Burner Unit, Hydra, S.B., Type E. The Burner Unit is the normal method of firing.

The exhaust pipe is screwed into a flange welded to the container at one end, and has a socket welded to its other end. The socket extends to just short of the inner surface of the outer casing. It is continued to atmosphere by screwing a nipple into the socket from the outside, and then fitting a

*Or two Burner Units, Hydra, S.B., Type E, in cases, with foot-pump, spare burner body, and kit of tools.

washer and locknut. The container is held in place by bars and by locating brackets welded to the inside of the outer casing, being *fixed* to the eight top locating brackets only by $\frac{1}{4}$ -inch B.S.W. screws.

By removing these screws, therefore, and undoing the exhaust pipe locknut and nipple, it is possible to remove the container and so give access to the boiler space.

The whole construction is of welded sheet steel, galvanized after fabrication.

2. Operating party required.

One trained man is sufficient. He will attend to boiler and burner, and will supervise disinfection and command the working party.

3. Working party required.

Four men as follows: Nos. 1 and 2 on the "dirty" side to prepare articles and load the disinfector; Nos. 3 and 4 on the "clean" side to unload, shake, and dispose of treated articles.

4. The boiler.

(a) *Starting up*.—Level the disinfector and open the pet cock. Fill through the filling funnel till the pet-cock overflows; about 8 gallons. Close the pet-cock.

(b) *Make-up water*.—Pour in at end of each disinfection cycle, *i.e.*, when unloading, about half a gallon. Use the pet-cock to check the quantity.

(c) *Low-water alarm*.—If the water-level is allowed to drop too low, the crown of the arch will become uncovered, and overheating, with damage, will result. If steam issues from the funnel the level has dropped too low and has exposed the opening from boiler to funnel, and water must be added at once.

(d) *Water overflowing from filling funnel*.—During disinfection the water-level in the funnel will rise, owing to the slight building-up of steam pressure. If it overflows, pressure is too high. Turn down or remove burner to relieve pressure and pour in water to make good the loss.

Excess pressure may be caused by over-tight packing, but is probably due to excess steam generation, in which case the burner should be run at less than full jet-opening.

(e) *Shutting down.*—Remove the lid and empty the boiler by tipping it over to spill the water over one edge. Finish by turning it completely upside down.

(f) *Cleaning out.*—Clean out the boiler occasionally as follows: take the locknut and washer off the exhaust pipe, and remove the nipple by unscrewing it with a tommy-bar passed through the two holes provided. Take out the eight round-headed screws inside the container. Turn the disinfector upside down on a hard surface, lift one end half an inch or so, and drop smartly, repeating if necessary with the other end. This will loosen the container. Stand the disinfector the right way up again and withdraw the container carefully, avoiding damage to the exhaust pipe. Remove sludge and scale from the boiler and re-assemble.

(g) *Storage.*—The boiler must be clean, empty and dry. The container and lid must also be dry inside.

5. The burner.

See Plate 5 and separate instructions later.

6. Disinfection.

(a) *Preparation of articles.*—Clothing, equipment, etc., should preferably be packed in blankets in bundles to fit the container, bound with the slings provided, but may be packed separately. Blankets are folded side to side, end to end, and then in three. Ten, or five, are then stacked lengthways in a rope sling, the loops of which are brought up over the ends of the bale, passed one through the other, and fastened.

As many loads as possible should be prepared in advance of disinfection, extra slings being made up as necessary.

(b) *Loading the container.*—See that articles are packed evenly, fit the container nicely, and are pressed down evenly on the bottom. Fill any spaces left with loose clothing or blankets, leaving no air-space at sides or ends. Preferably put an old blanket on the top to absorb water dropping from the underside of the lid. Put lid on with arrow pointing to filling funnel. One bale of ten blankets, or two of five, with a covering blanket, form a load.

(c) *Steaming.*—"Full bore" steaming is usually obtained in six or seven minutes, and disinfection completed three minutes later.

If, with a full load, "full bore" steam issues within four minutes, or if steam flow is still intermittent after 10 minutes, open up, re-pack, and try again.

(d) *Unloading*.—If articles are packed one by one, unload them one by one *only as fast as they can be shaken out*. If packed in bales or bundles, take out the whole bundle, but again remove each article from the bundle only as it can be shaken out. Do not leave bales or bundles lying about awaiting shaking.

(e) *Shaking out*.—Give every article at least eight vigorous shakes *immediately* on removal from container or bale, and it will be nearly as dry as before disinfection. Air on improvised drying lines for half an hour if desired and weather is suitable.

• (f) *Leaks*. (1) *Steam leaks*.

(i) *Past lid-packing or rivets to atmosphere*.—Only affect disinfection by reduction in quantity of steam available, but may injure persons and will cause rust. Correct at once. Later models have adjustable cam-links for the lid clamps, but with early models it will be necessary to adjust the asbestos packing. Demands for spare cam-links will be met by the adjustable kind.

(ii) *From boiler to exhaust pipe*.—Will be detected by immediate continuous issuing of steam from exhaust pipe as soon as the lid is clamped down on a load. (Fatal to disinfection, and must be repaired at once. Probably due to weld-failure in the pipe, or a leak past the screw-threads of the flange.) Do not confuse this with the slight emission of steam evaporated from the bottom blanket, if damp, by the hot container.

(iii) *From boiler to inner container*.—Fatal to disinfection. Can be seen by immediate issue of steam as at (ii) above, if leak is at joint of exhaust pipe to container, and by too early emission of steam if at a seam. In the latter case, water of condensation will appear at the leak when the lid is off after unloading.

(2) *Water leaks*.—(i) At exhaust pipe washer: tighten locknut or replace washer.

(ii) Into tunnel arch: metal is burnt through and must be patched or a new outer casing obtained.

(iii) By runners: weld up.

(g) *General*.—Operate the disinfector under cover in cold, windy or wet weather. Shield from draughts. (See Plate 5 for an improvised burner wind shield.)

Beware of the exhaust end of the tunnel when firing. The exhaust gases will burn clothing in a few seconds. It is best

to raise a baffle of brick or stone. Beware also of the hot lifting handle at the exhaust end of the tunnel after shutting down or removing the burner.

Provide ground covering on each side of the disinfector on which to dump articles.

Keep untreated articles well away from treated articles, and do not let the working party wander about between "clean" and "dirty" sides.

Before storage, see that container and lid (including felt) are dry inside, and the boiler empty.

7. Quantities, etc.

Boiler holds about 8 gallons.

Water consumption, about 3 gallons per hour. Output in blankets, 40-50 per hour.

Weight (empty), 130 pounds.

Overall size: 2 feet 9 inches long, 1 foot 7 inches wide, 2 feet 6 inches high.

Plate: 18 gauge, except tunnel arch, which is 16 gauge.

Disinfector is issued with three rope slings, one 72-foot drying line, and two burners. Parts are interchangeable, and spares may be demanded from D.A.D.O.S. in the usual way.

CHAPTER IV.

DISINFECTOR, PORTABLE, FIELD, No. 3.

1. General description. (See Plates 3 and 4.)

For ease of handling the disinfector is made in two halves bolted together. The front, or "burner," half carries a detachable tank for make-up water and a gauge-glass to show boiler water-level. The back, or "flue-box," half carries the detachable flue-box and a pipe which, being open to atmosphere, serves the double purpose of low-water alarm and pressure-limiting device. The bottom of this pipe is immersed in the boiler water at a level just above the crown of the fire-tube.

These two halves are of generally identical construction. Each has a horizontal bolted joint, so that the bottom or boiler section can be removed for cleaning or repairs. Through this bottom section runs the fire-tube, around which is a 2-inch

water space. The top or container section carries the disinfecting container, between which and the outer walls is a 1-inch steam space sealed at the top. From this steam space, which jackets the chamber, steam is drawn off for disinfection, being re-admitted through a three-way cock and piping to the container above the charge.

The front and back halves are interconnected by :—

- (a) A loose fire-tube connector.
- (b) A water pipe assembly, to equalise the water-level and to provide means of draining the water-spaces.
- (c) A steam-pipe assembly, to collect into a common main the steam generated in both halves, and to pass it to either disinfecting container separately or to both containers simultaneously.

The water and steam pipe assemblies are joined to the disinfector body by "unions" with ground faces. When the union nuts are slacked off, the entire assembly comes away in one piece. The ground faces, when exposed, *must* be carefully protected from rust or damage.

The construction of the disinfector is light, and it must be handled, dismantled, assembled and transported with reasonable care.

The operation of the disinfector is as follows :—

Steam having been raised, one container is loaded as described later, while the steam is diverted by the three-way cock to the other container. When the first container is loaded and lid clamped down, the three-way cock is thrown hard over to admit *all* steam to the loaded container. The second container is then loaded, after which the three-way cock is put to the mid-way position to admit steam to *both* containers simultaneously. After some minutes' steaming (about 12 with a full load of blankets), steam will issue at "full bore" from the exhaust pipe of the first container. After 3 minutes of such full-bore exhausting disinfection of that container is complete, and the three-way cock is set to pass all steam to the second container, while the first is emptied and re-loaded. By this time the second container may have completed its 3 minutes of full-bore exhausting, in which case all steam is passed to the new load in the first container, while the second container is re-charged. If not, steam is turned on to both until disinfection in the second container is complete.

It will be seen that most efficient and easy working will result if the two containers complete their respective loads at equal intervals of about 8 minutes, since the "cycle" will

consist of, say, 12 minutes to obtain full-bore exhaust, 3 minutes full-bore exhausting, and 1 to 2 minutes for emptying and re-loading. Adjustment to this ideal should be made, if necessary, by prolonging the steaming of both containers, not of one only, since passing all steam to one container for an unnecessarily long time may cause the pressure to build up enough to blow water out of the low-water alarm pipe.

The disinfecter is NOT fool-proof. It is simple and effective, but careful attention to the following instructions is necessary to achieve satisfactory working and reasonable life.

2. Operating party required.

No. 1: attends to boiler and burner.

No. 2: "dirty" side—loads the disinfecter with bales of articles passed up to him.

No. 3: "clean" side—unloads the disinfecter and operates the three-way cock.

NOTE.—The "clean" side of the disinfecter is the three-way cock side.

3. Working party required.

A party to fold, bale and pass articles for disinfection to No. 2 will be required on the "dirty" side.

A party to unbale, shake out, re-fold and stack disinfected articles received from No. 3 will be required on the "clean" side.

There should be no passage of persons between "dirty" and "clean" sides, and the only passage of articles should be *via* the disinfection containers. Rope slings must be tossed back from the "clean" to the "dirty" side for re-use.

The size of the parties will depend on the nature and quantity of the articles to be disinfected. The output of blankets is around 200 per hour, and this will require, say, four men on the "dirty" side and six on the "clean" side for continuous working.

4. The boiler.

(a) *Starting up.*—The disinfecter must be *level* for use, *i.e.*, there should be not more than 1 inch difference of level between water-tank and flue-box or between the side plates. Otherwise there is a danger of part of the fire-tube crown becoming uncovered by water. In no circumstances must the difference of level exceed 2 inches, and if it is over 1 inch, the highest part should be the corner where the low-water alarm pipe is.

The boiler is filled *via* the water tank and its strainer. Don't take the strainer out when filling. Fill the boiler till the water shows $\frac{1}{2}$ to 1 inch in the gauge glass. Then shut the water-tank cock and fill up the water tank. There will then be about 40 gallons in the boiler and 18 gallons (enough for two to three hours' steaming) in the water-tank. The total steaming time then available altogether before the low-water pipe blows steam will be about 4 hours *with a level disinfecter*.

(b) *Make-up water*.—Keep the water showing in the gauge-glass—say $\frac{1}{2}$ inch up. If the water surges when steaming, the lowest point of the surge is taken as the water level. Feed in the make-up water slowly by opening the water-tank cock while steaming both containers. When the full volume of steam is being passed to one container only, the steam pressure may equal or exceed the feed-water head unless the tank is full, and consequently water may not flow—in fact, steam may escape into the tank. Do not forget to turn the cock off again when enough water has been run in. Feed *little and often* to prevent bad fluctuations in steam volume. With experience a No. 1 will learn the setting of the water-tank cock, so that make-up water is fed in at practically the same rate as loss by evaporation.

(c) *Shutting down*.—It is necessary to drain the boiler frequently to carry off sludge, and to prevent corrosion at the water surface. If the disinfecter is in daily use, such draining may be done weekly only; if in intermittent use, drain every time of shutting down.

Never leave the boiler full more than a day or two without use.

5. The burner.

This is a Burner Unit, Hydra, S.B., Type E (*see Plate 5 and instructions which follow later*).

6. Disinfection.

(a) *Preparation of articles*.—(i) Provide suitable ground covering to protect articles from dirt and damp. Collect articles for disinfection on the "dirty" side clear of the vehicle.

(ii) *Clothing and equipment*.—The best method of preparing these depends on the exact nature of the charge. They may be put in blankets to form bundles of container area, or loaded directly in layers using blankets or clothing to fill in the spaces, especially round the container sides.

(iii) *Blankets* are folded end to end, side to side, and then again end to end, and are stacked in eights on the slings provided. (See Plate 7 for method of baling and fastening.)

(iv) *Biscuits*.—In disinfection of biscuits, a number of blankets is required to make up the load. Three blankets, folded as for baling, are first placed in the bottom of the container. Six biscuits are then wrapped tightly in one blanket, and the bundle of six inserted, end downwards, into the container. A further three or four or more folded blankets are finally added on top of the bundle of biscuits to fill up the container.

(v) *Mattresses* will not readily fit into the container, the width of the mattress being greater than the depth of the container. Disinfection of single mattresses can, however, be carried out if the mattress is rolled tightly and tied and inserted diagonally within the container, the triangular spaces below and above being tightly filled with loose blankets and other articles. If a fair number of mattresses has to be done, it may be advantageous to leave the underneath packing in place as a "nest" for each rolled mattress, which should be prepared for instant loading to reduce the time the "nest" is exposed to air.

(vi) Make up plenty of bales or bundles while raising steam, and keep them always ahead of No. 2's requirements.

Twenty slings are provided with each disinfector. Extra slings can be made up from any suitable rope.

(b) *Loading the container*.—When the lid is taken off for the first time after raising steam daily, a certain amount of condensation may be found in the container. Mop it up; it will then remain dry as long as steam is kept up.

Load smartly as soon as the lid is off. Press the bales down flat so that they fit the container well. Do not load above the level of the steam inlet. The normal load is four bales each of eight blankets. If there is room it is a good idea to finish off with one loose blanket spread over the top bale to absorb condensation from the lid. The same blanket would be used for all the charges. No blanket is necessary *underneath* the charge.

As soon as the container is loaded, replace lid and clamp down, then turn on steam. A smart pair, Nos. 2 and 3, can empty and re-charge a chamber with blankets in a minute or so.

(c) *Operating the steam cock*. (See Plate 4.)—When the handle of the three-way cock is in the midway position, steam is being passed equally to both containers. When it is hard

over to one stop, it points to the container which is receiving all steam, the other container then being shut off. It should *always* be either midway or hard over.

When raising steam from cold put the handle midway, to warm up both containers. After about 45 minutes the boiler will be steaming fully; then put the handle hard over and open up the container shut off, load it, and clamp down lid. Throw the handle hard over to pass all steam to the loaded container, open up the second container, load and close down lid. At once put the handle midway to steam *both* containers.

At first air only (with perhaps a little steam as the blankets dry out) will come out of the exhaust pipes, then steam and air, and, soon after, steam only at full-bore. Let the container exhaust steam at full-bore for 3 minutes, then throw the handle over to shut off steam from it, open it up, re-load, clamp down and return the handle to mid-position. Similarly for the second container and so on throughout disinfection.

Always shut off steam from a container before undoing the lid-clamps. No. 2 must obey No. 3's commands regarding the clamps on his side.

(d) *Unloading and shaking*.—No. 3 will hand down or drop over the vehicle side each bale of blankets as he removes it. Each pair of the "clean" side working party will take one bale, undo the sling, and take off the blankets one by one from the top. Unfold the blanket, take it by the four corners, and give it at least eight vigorous shakes. Do not take any blanket from the bale till ready to shake it.

Shaking must be really vigorous. If the contained steam is allowed to remain and condense in the blankets they will be too wet to use. If well shaken they will be nearly as dry as before disinfection. If the atmospheric and other conditions are suitable, the blankets may be aired by being hung for half an hour on a line. Otherwise they should be re-folded and stacked as soon as shaken out.

Mattresses and biscuits should be stood on edge while men pat each side smartly until all evidence of steam has gone. This must be done immediately on withdrawal from the container. The top biscuit should be so treated first, the others remaining in the blanket until it is finished, when the next biscuit is taken out, and so on.

No. 1 should keep his eye on the working parties, and keep them up to the mark. The articles must always be kept out of dirt and damp. Slings should be promptly tossed back to the "dirty" side working party for preparation of more bales.

7. Points in management.

(a) It is *not* necessary—in fact, it is disadvantageous—for any appreciable steam pressure to be built up. If water is blown out of the low-water alarm pipe the pressure is too high. This may be caused by running too long on a single container only, or by excessive steam generation, or by a combination of both. If it happens, turn down the burner slightly and run in some fresh water to reduce steam and make up the amount of water blown out.

The amount of steam required for efficient disinfection is such that when both containers are steaming, the steam issues at “full bore” from each exhaust pipe. Using the Hydra burner unit in warm weather or inside a building, no external insulation of the sheet steel sides of the disinfecter will be necessary. In other circumstances it is desirable (and in exposed, cold conditions, necessary) to fit an insulating blanket for each half of the disinfecter as follows :—

Sew two unserviceable blankets together end to end, and fold longitudinally. Pass the folded blankets behind the $\frac{3}{8}$ -inch diameter rod provided just below the lid clamp fixings, then under the disinfecter and up the far side to hang over the other $\frac{3}{8}$ -inch rod, and fasten the ends of the blankets back over the $\frac{3}{8}$ -inch rod. The insulating blankets should fit snugly, holes being cut for the exhaust pipes and stand fixing brackets.

An intelligent operator can use these blankets to reduce fuel consumption (the burner being run at slightly less than full jet opening) in conditions where they are not strictly needed, and their provision is recommended.

(b) Keep all articles away from the flue box, which gets hot enough to burn.

(c) *Shortage of water at site.*—If water is very short, disinfection may be continued, after the available make-up water has been all used, until the low-level pipe blows steam. If the disinfecter is level, this will be about one hour after the water level has dropped out of sight in gauge glass. Any charge still in the container at the time when the low-level pipe blows will, of course, NOT have been properly disinfected.

The boiler must not be fired again, of course, until it has been filled up to its proper level.

(d) *Effect of wind on burner.*—Wind may interfere with the flue draught. Shield the burner and flue outlet and, better still, locate the whole disinfecter in a sheltered position. The improvised wind shield shown on Plate 5 is recommended to be provided for all outdoor work.

(e) *Operation off the vehicle.*—Normally it will be desirable to break down the disinfecter into its two halves for off-loading from a vehicle or loading up from the ground. To do this, remove the water-pipe assembly, undo the steam assembly union on the water-tank half, and take out the eight bolts that hold the two halves together. All union nuts are attached to the *container or boiler* half of the union, and must therefore be turned *clockwise*, when looking at the disinfecter, to loosen. Pull the halves apart, being careful not to damage the union faces, and remove the fire-tube connector. Take off the lids to lighten the loads further, slide each half back to the tailboard, and lower it down to the ground. When it is on the ground *carry* it, or push it on rollers, to the place of re-assembly. It weighs, roughly, 400 pounds.

Whenever the disinfecter is moved on the ground, whether assembled or not, *do not drag it along*. It has been provided with angle framing to the base to enable pipe to be used as rollers to move it in any direction (except the first few made). See also that the weight never comes on the boiler bottom.

When it is dismantled, care must be taken not to damage the exposed faces of the unions. Dismantling, lowering to the ground, and re-assembling for use takes four or five men half an hour. When re-assembling see that the asbestos packing for the fire-tube connector is in place.

With lids removed, the empty disinfecter weighs 870 pounds. With a careful party of eight men, it can be loaded and off-loaded without dismantling. To off-load, remove holding-down clip bolts and lids and slide the disinfecter back (with the tailboard full down) till it nearly balances. Take the weight and lower till the burner end angle iron framing reaches the ground. Then take the weight at the chimney end while the lorry is driven away, and lower right down gently.

When there is a possibility of re-loading on to a different vehicle, keep all the tools and accessories, including the holding-down clip bolts and nuts, with the disinfecter. When operating on the ground, do not forget the gauge-glass, which will be at an awkward level to see. For prolonged operation in a building, remove the water-tank and mount it separately at a suitable height with a longer length of rubber tubing, thus revealing the gauge-glass to plain view.

(f) *Packing accessories.*—Do not pack tools and accessories (other than slings and rubber pipes) inside the containers for transport. The metal is only 16 gauge, and will be damaged, as will the welding and galvanizing. The stands can be slid under the boiler bottom.

(g) *Stands.*—In early models the long bolts on which the stands are hooked were fitted centrally. It is better to move

them one bolt space inwards towards each other, which by bringing the stands closer together prevents an accident, due to the foot being put down in the space between them.

8. Repair and maintenance.

(a) *Repair of sheet metal.*—The disinfector has not yet had enough use to show which part will, under fair wear, fail first. If the failure is due to rusting or burning through the sheet steel, the worn part can be cut away and a patch welded on if thought worth while. The gauges of metal of which the disinfector is made are as follows:—

Bottom halves, including fire-	
tube	14 gauge.
Top halves, outer casing ..	14 gauge.
„ „ inner container ..	18 gauge (early models).
	16 gauge (later models).
Water tank	16 gauge.
Flue box	16 gauge.
Lid, top	20 gauge (early models).
	18 gauge (later models).
Lids, underside	26 gauge.

(b) *De-scaling the boiler.*—Scale on the fire-tube has a great effect in preventing heat from the burner flame reaching the water and overheating the tube, which would shorten its life. The rate of formation of scale, and its nature, will depend on the water used. It is probable that on the average the boiler can do 400-500 hours' steaming between de-scaling, but this depends on local conditions and the amount of use. The scale should never be allowed to grow to over $\frac{1}{8}$ inch in thickness on the fire-tube. An idea of the extent of scaling can be got by removing the gauge glass gun-metal cover and glass (being careful not to damage the gasket, which need not be removed). A long screwdriver (as a scraper) and a torch (with lens removed for preference) will then enable the scaling on the fire-tube crown to be judged. Owing to "piling up" on the end of the scraper if the scale is soft, there is a tendency to over-estimate the thickness of the layer. It is important to remove all scale from the top, sides and bottom of the fire-tube, and also to remove all loose pieces of sludge from the 2-inch water space round and below it.

To clean the boiler the disinfector must be dismantled completely. First split it into two as previously described, then take off the top parts of each half.

In the case of the back half, it will be necessary to take off the flue box to break the horizontal joint. The front half bottom can be removed without taking off the water tank.

First slack off the nuts until they are only half-threaded on

the bolts. Then tap the nuts to drive the bolts partly through the gasket, which may grip them fairly closely. Take off the nuts and finish removing the bolts by tapping, using *wood packing* to prevent damage to end threads, or by unscrewing them through the gasket. Be careful not to lose any, as you have no spares.

Then turn the disinfector on its side or end on wood packing. There is a spigot which stands up $\frac{3}{8}$ inch inside the joint all round the bottom section, so that the joint must be parted by a $\frac{1}{2}$ inch to clear it before the two parts can be separated. Breaking the joint must be done very carefully. The gasket will probably have stuck to the angle iron, especially at the corners where any jointing compound used at the scarf will have squeezed out on tightening. Using strong leverage between the angle flanges along the sides will bend the flanges without affecting the sticky parts. Scrape away surplus jointing material at the edges, and then apply reasonable leverage between the flanges at the corners where the horizontal angle-iron is stiffened by the vertical angle-iron. When it begins to part, ease it all along the sides.

Parting the joint may prove to be more difficult the first time than subsequently, owing to the over-use of jointing material at the scarf by a certain manufacturer. It should not be taken that a similar quantity is necessary when re-making.

When the boiler section is off, scrape the scale away from the top and sides of the fire-tube (and the bottom so far as you can get at it) *without damaging the galvanizing*. Firmly adherent scale on the outside shell does not matter, unless it is over $\frac{1}{4}$ inch thick. It saves heat from being lost to the outer air, but may reduce the water-space to the point where loose scale may bridge the gap before the next de-scaling.

After scraping, remove *all* loose sludge and scrapings, especially from under the fire-tube, and swill out with water.

If the old gasket is still in good condition, re-use it. If not, fit the spare gasket. This may be found to be either already prepared and holed for use, or it may be in one continuous 21-foot length. In the latter case, cut off the exact lengths required (there is little over to allow for extravagance) and scarf the ends in the same way as the old joint. Between the faces only, at each scarf, put a *little* white-lead paint "ground in oil," or thick paint. Having set the gasket in position on the boiler section (now right way up, of course), dust the top surface of the gasket with powdered graphite and lift on the container section. Be careful not to shift the gasket. Then, if the gasket is un-holed, punch the holes as follows: using a $\frac{3}{8}$ -inch taper punch, punch the corner holes and bolt them up

reasonably, but not fully tight. Then punch and bolt up the centre holes in each side. Then do the others. Lastly, tighten up the nuts all round.

When the front and back halves are being re-assembled together, do not forget the asbestos rope rings on the flue connector. Test for water-tightness *before* replacing chimney. On warming up, take up any slack on exposed nuts.

Before re-using bolts, nuts and washers, clean them well in oil and put them in oily. Throughout, take great care not to lose any, as you have no spares. The whole task, as described above, will take four men about 5 hours, and is preferably done by a workshops staff.

(c) *Leakage of steam.* (1) *Past lid.*—Leakage of steam, if slight, past the asbestos packing of the lid will not affect disinfection. If the leakage is big enough to reduce appreciably the volume of exhaust, particularly when steaming both containers, it may result in incomplete disinfection. For safety in handling and operation, the leak should be stopped. It will be necessary to adjust the packing on early models which have no means of adjustment of the cam link of the clamp, but on the later models it will probably be possible to stop the leak by slightly shortening the cam link.

Demands for replacement of cam links or complete clamps will be met by the adjustable (screwed) variety.

(2) *Into container.*—Any leakage of steam direct from steam space (of boiler) to the inner container will (unless it occurs only above the top of the charge) inevitably prevent parts of the charge from being disinfected. If, therefore, a leak is seen in either container it must be immediately repaired, and the container affected must not be used for disinfection until the leak has been stopped by patching, welding or soldering. This rule should be followed even where the leak is above the charge (*e.g.*, in the top lip of the container), or injury to persons may follow when loading or unloading.

A leak direct from boiler into exhaust pipe will similarly spoil disinfection. It will be revealed by steam issuing from the exhaust pipe of the container concerned when steam is shut off from it at the three-way cock.

(3) *To atmosphere via unions, gauge glass gasket, outer casing seams, cam link fixings, lid rivets, etc.*—As in the case of leaks past the lid packing, these only affect disinfection by reducing the quantity of steam available for passing to the chamber. In spite of this they should be stopped at once.

(d) *Leakage of water.* (1) *Through boiler gaskets.*—Deleterious, but does not affect disinfection. Repair at once by tightening any loose bolts or fitting spare gasket.

(2) *Into fire-tube*.—The metal has gone at a seam or has burnt through, and the disinfector cannot be used until repaired, or a spare bottom section fitted. Demands for spare bottom sections will be met by sections having double drain-pipe connections, so as to be suitable for either front or back halves.

(e) *General*.—Replacement of any part can be demanded from D.A.D.O.S. as parts are interchangeable. Before storage, empty boiler and water-tank, and see that containers and lids are dry inside.

9. General notes on quantities, etc.

Boiler holds about 40 gallons of water.

Feed tank holds 18 gallons of water.

When boiler and water-tank are full and disinfector is level, the total *steaming* time available till low-water alarm pipe finally blows steam is about 4 hours.

Burner takes about 7 pints of petrol per hour and lasts about 2 hours when full up. Burner takes about 45 minutes to raise full steam from cold.

Output in blankets is about 200 per hour.

	Cwts.	Qrs.	Lb.
Weight back half, including lid and flue box	3	3	20
Front half, including lid, water tank, fire-tube connector, and all the piping and valves	4	2	6
Total weight (empty)	8	1	6
	(= 950 lb.)		

Total weight (boiler and water-tank full), 1,530 lb. or, say, 14 cwts.

Each lid weighs 39 lb.

With lids, fire-tube connector and piping removed, each half weighs 390 lb.

The above weights are for the later models with 16 gauge chamber and 1½-inch angle longitudinal runners.

10. List of parts, tools, etc., comprising complete outfit.

Disinfector complete, with water-tank, flue-box, pipe assemblies ; two 3-foot lengths 2-inch rubber hose ; one 6-foot length of 1-inch rubber hose for drain pipe ; 4 holding-down clip bolts, washers and nuts ; 26 tail rope

slings for blankets; four removable stands, and spare gasket material, $1\frac{1}{4}$ inch $\times$ $\frac{1}{4}$ inch—either 21 feet in one length, or already holed and scarfed into 2 joints, one for each section.

Also—

Burner Unit, Hydra, S.B., Type E	..	..	..	2
Wrenches, Stillson, 18 inch	..	..	..	1
Spanner, D.E., $\frac{3}{8}$ inch $\times$ $\frac{1}{2}$ inch	..	..	..	1
„ „ $\frac{1}{4}$ inch $\times$ $\frac{5}{16}$ inch	..	..	..	1
„ Adjustable, 12 inch	..	..	..	1
Pails, iron, galvanized, 3-gallon..	..	..	..	2
Gauntlets, leather, or equivalent	..	..	prs.	2
Vehicle and tarpaulin.				

CHAPTER V.

THE BURNERS.

BURNER, OIL, No. 1.

1. General description. (See Plate 6.)

(a) *Method of atomization, and fuels used.*—The burner, which is one of the Rutherford type W3 range, operates somewhat similarly to a carburettor, in that fuel is carried away to be burnt from a fuel jet by a stream of a medium by which it is atomized. As, however, there is no suction, such as that given in an engine by the piston, to draw the atomizing medium past the fuel jet, it is forced past by pressure. The atomizing medium is air (when starting) or steam (when running).

The burner is therefore fitted with two tanks, 1 and 2. Of these one contains fuel and the other water. The water tank 2 is put under pressure by pumping in air. When first starting up the whole burner is cold, and since steam is not available the medium used to atomize the fuel is air, which is taken from the air-space above the water in the water-tank. As soon as the “boiler tubes” are hot enough, the air is turned off and water turned on. This flashes into steam in the “boiler tubes” (not illustrated) of the burner.

If sufficiently fluid, the fuel is fed to the fuel jet by gravity, and the fuel tank 1 is not put under pressure. This is the arrangement in Burner, Oil, No. 1. Heavier oils, such as lubricating oil or sump oil, will not flow well enough to feed

“Numbers in the text refer to parts so enumerated in Plate 6.”

the fuel jet unless put under pressure, and are not suitable for use with this burner unless the pressure additions are fitted. The tank is made so that the addition can be fitted if necessary.

The normal fuel for the Burner, Oil, No. 1, is Diesel engine oil. Paraffin or crude oil (such as Kirkuk oil from the Iraq-Palestine pipe line) may be used. Heavier oils may also be used if mixed with paraffin so as to flow readily and ignite freely. *Petrol must not be used.*

A generally similar burner, known as Burner, Oil, No. 2, is provided with Mobile Bath Units. The No. 2 Burner is, however, fitted with a thermostat as a safeguard, and has a totally different arrangement of jet and boiler tubes, and is NOT suitable for use with disinfectors unless converted.

(b) *Detail of operation.* (See Plate 6.)—The fuel flows from the fuel tank 1 down through a stop valve 7 (which is kept open except when dismantling the filter) to a filter 8. After filtration it continues via a copper pipe to the fuel metering valve 5, and thence to the fuel jet (not shown).

The water tank 2 is put under pressure by pumping in air at Schrader valve 10 with a foot-pump. There are normally two outlets from the water-tank (see scrap view, Plate 6). One is a pipe which leads from the *air-space*, above the water, to the "Start" valve 22A below the tank. The other leads from the *water-space* to a similar "Run" valve 21A. The outlets from these two valves are connected by a "T" piece to a common pipe running down to the burner, to which it is connected at 19. This pipe therefore carries either air or water to the burner, depending on whether valve 22A or 21A is open. One or the other must *always* be open when running or the flame will fail. The two valves, 21A and 22A, were formerly combined into a single three-way valve (3 in main diagram). The pipe leading from the tank 2 to this valve was a double one, the outer pipe being open to the water-space, while the inner one extended up to the air-space. The three-way valve therefore passed either air or water, according to its setting, and was marked START (for air) and RUN (for water) accordingly.

On arrival at the burner at point 19, the water (or air) passes through "boiler tubes" (not shown), in which it is heated by the burner flame, to a jet called the steam jet. By the time water arrives at the steam jet it has been converted into steam, which, rushing out past the fuel jet, carries fuel away and atomizes it.

The burner is run with valves 22A or 21A full open. The fuel supply is controlled by the fuel metering valve 5. The supply of air for combustion is regulated by the rotatable shutters 16 and 17, which are normally run full open, except

in a wind. The pressure in the water-tank, which is shown in gauge 2A, can be adjusted either at a pressure regulating valve, formerly supplied fitted to the water tank inlet, or, in later burners from which this valve is omitted, by the lever on the end of the pump connection.

Supplies of three-way valves are not now obtainable. Plate 6 shows how the two-independent valve arrangement can be fitted to tanks in place of the three-way valve, of which many exist in the Service. The second valve (start valve, 22A) is fitted into the opening left by dispensing with the water-tank drain valve 13, and the tank is drained by breaking the connection 19.

The whole burner with tanks, etc., is mounted in a stand having adjustable legs so that it can be set at the correct height for the disinfector fire-tube opening.

It is important to understand that unless and until the boiler tubes are hot enough to generate steam, the burner must be run on air. If the flame goes out when running, the tubes will fill with water and cool down. Re-lighting will have to be done by switching over to air again temporarily.

The fuel tank holds 6 gallons. Consumption is about 1 gallon per hour. If care is used, re-filling may be done while the burner is in operation with the disinfector, but it should always be filled up before starting, and will then probably last out the task. The water-tank holds 1 gallon, which will last 12 hours or so. The water-tank cannot be over-filled, provided the valves are shut. No dipstick is therefore necessary.

Be very careful not to get any water in the fuel tank. When both water and paraffin are being used in the same appliance, mistakes are easy.

2. Preparing burner for use and lighting up.

(a) Adjust to correct height so that the burner nose is central in the disinfector fire-tube. Close all valves except stop-valve 7. Fill fuel and water tanks with *clean* fuel and with *clean* water respectively. Connect foot pump to valve 10 and pump up to 30 lb. pressure.

(b) Light lighter 11 and insert through lighting door 12.

(c) Open starting valve 22A (or "START" of three-way valve where this kind of valve is fitted) and fuel metering valve 5.

(d) As soon as the burner lights, remove lighter and continue pumping while the burner heats up, until the upper hexagon

plugs at the back of the burner are too hot to touch (say 5 minutes).

(e) Slowly open run valve 21A (or "RUN" of three-way valve) and slowly close start valve 22A (or "START" of three-way valve). If 21A is opened too soon or too suddenly, the boiler tubes will be cooled so much that steam is not formed and the heating-up process will have to be repeated. If 22A is shut before 21A is opened, the flame will go out.

(f) Pump up to required pressure from 20 to 30 lb., depending on flame intensity required.

3. Adjustment of flame.

(a) *Correct flame.*—The hottest flame is a rich orange colour just verging on smoke. Open the fuel metering valve 5 until smoke shows at the chimney; then close slowly until the smoke just disappears. The setting will vary with the water-tank pressure.

(b) *To reduce flame.*—Lower the pressure in the water-tank slightly by allowing air to escape *either* through the pressure regulating valve (not shown), if fitted, *or* by turning to a vertical position the lever on the end of the pump connection where it fits on to Schrader valve 10. Reduce fuel feed by partially closing metering valve 5. So adjust water pressure and fuel flow to meet requirements of flame.

Pressure regulating valves are not fitted to burners of present supply.

(c) *To increase flame.*—Increase the fuel flow by opening valve 5, and the air pressure with the pump. Do not pump pressure above red line on gauge.

(d) *Use of air shutters.*—The air shutters 17 and 16 are normally wide open, but in a strong wind may need to be both closed. Adjust to suit conditions. When closing, close primary shutter 17 first.

Continuous running with shutters unnecessarily closed tends to cause boiler tubes to burn out.

4. To shut down.

(a) Open start valve 22A and close run valve 21A (or, with three-way valve, open "START" and close "RUN").

(b) Close fuel metering valve 5.

(c) Open cleaning valve 6 two turns. This allows escape through its large opening in preference to the small jet, and so carries off impurities from the boiler tubes.

It also, of course, reduces the pressure in the water tank.

(d) When all pressure has gone, close starting valve 22A ("START" of three-way valve) and cleaning valve 6.

5. Precaution against frost.

After stopping burner as in 4 above, pump up pressure in water-tank and drain as follows :—

- (a) *If fitted with three-way valve.*—Open drain valve 13, and close when tank is empty and pressure gone. *If fitted with valves 22A and 21A.*—Uncouple the water-pipe at the connection 19 to burner, and then open run valve 21A. The burner must be tipped to empty out the tank completely, as the connection to valve 21A is not exactly at the bottom of the tank. When empty, close run valve 21A and re-connect at 19.
- (b) Then pump up pressure in water-tank again, and open start valve 22A. When all pressure has gone, close valve 22A.

6. Maintenance.

(a) *Clearing steam jet and blowing out boiler tubes.*—This is necessary on first using after prolonged storage, but should not be necessary during use if the burner has been well cared for.

Light the burner as previously described, and let it get thoroughly hot. Then stop by closing fuel metering valve 5 and running valve 21A (or "RUN" of 3-way valve). Remove cleaning valve 6 and take out steam filter. Momentarily open and close valve 21A ("RUN" valve), and then open 22A ("START" valve of 3-way valve). This will blow out any loose deposit which may have formed in the boiler-tubes. Close 22A.

Next clean the steam jet as follows: use the steam jet cleaner, which is the brass rod with a spring on one end in the tool roll (the spring protects the actual cleaning needle from damage). Insert the cleaner into the hole left at the back of the burner by the removal of valve 6 and of the steam filter, and revolve it gently until the needle is felt to enter the hole in the steam jet. Never try to insert it into the steam jet from the *front* of the burner.

Then replace steam filter and cleaning valve.

NOTE.—After a long period of running in a sandy district, the four small airholes round the base of the steam jet may tend to silt up. To clear them, place a strip of metal, such as a steel rule, over the mouth of the steam jet and blow air

through by opening starting valve 21A ("START" of three-way valve). It will be necessary to remove the burner casing to examine these airholes.

(b) *Checking fuel flow.*—Check that there is suitable fuel in the tank and that the airhole in the neck below the filler cap is clear.

Remove burner case and open fuel metering valve 5, when fuel should be seen flowing freely from the fuel jet. If it does not, give the handle on top of the fuel filter 8 a turn, which will clear the filter. If fuel still fails to flow freely, the fuel jet must be cleaned.

(c) *Cleaning fuel jet.*—Remove burner case and disconnect fuel metering valve 5 at the union between it and the burner. Remove nut surrounding fuel inlet to burner. The fuel jet bracket will then slide out forwards. Remove the jet from the bracket, and wash both it and the bracket in petrol or paraffin, and blow out any dirt. Before replacing, open momentarily fuel metering valve 5 to swill any loose dirt out of the fuel line. Replace fuel jet and bracket, making sure the locating pin is correctly aligned, replace nut, re-connect fuel metering valve and replace burner case.

(d) *Cleaning fuel filter.*—This is cleaned automatically by turning the handle on top of it. Dirt collects in the sump, which should be cleaned periodically by removing the plug in the bottom after closing valve 7.

(e) *Draining fuel tank.*—Close fuel valve 7 and drain tank by removing plug 14.

(f) *Cleaning boiler tubes.*—It should rarely be necessary to give these any other cleaning than that described in (a) above. If it is, proceed as follows: *While the burner is hot*, slacken the four hexagon plugs on the back of the burner, draw out the core rods and clean them. With the wire brush provided in tool kit, brush out the tubes. Before replacing the core rods, blow loose dirt out of the tubes by opening valve 22A ("START" of three-way valve) with the water-tank under pressure. Close valve 22A again, and replace core rods and hexagon plugs after smearing the plugs with graphite cement, which is supplied with the tool kit. NEVER USE RED LEAD. The function of the stainless steel core rods, which are rather like reamers in appearance, is to prevent surging of the flame. It is possible that, in the future, they may be made of spiral steel strip.

(g) *Changing boiler tubes.*—Take the casing off the burner, so exposing the boiler tubes to view. *While the burner is still hot*, slack off the union nuts around boiler tubes. The boiler

tubes may then be withdrawn. When replacing, see that the copper washer in the boiler tube is in good condition and not dented, and make sure that both legs of the boiler tube are right down on the shoulders in the main bracket. Tighten union nuts firmly. Extra tightening may be necessary after burner has heated up.

When fitting a *new* boiler tube, fit a new copper washer also. The old washer may be damaged in removing it from the old tube. Place the parts of the simplifix coupling on each leg of the boiler tube in the following order: (1) Union nut, (2) Collar, (3) Copper washer. Then assemble into burner as described above.

7. Preparing for storage.

The boiler tubes, if left for a long period with water in them, even in only small quantity, may develop pinholes. They must therefore be thoroughly dried out before storage, *i.e.*, if the burner is to be laid by for a month or longer.

Drain water as described in para. 5. Then relight burner (using start valve 22A) for two minutes to dry out the boiler tubes completely.

8. Failure to burn properly.

If the burner fails to respond properly to the procedure given in paras. 2 and 3 above, it should be examined in the following respects and put right where necessary:—

- (a) Fuel tank vent and fuel filter clear—*see* para. 6 (b) and (d).
- (b) Fuel jet clear and fuel flow satisfactory—*see* para. 6 (b) and (c).
- (c) Boiler tubes clear—*see* para. 6 (a).
- (d) Steam jet and airholes clear—*see* para. 6 (a).
- (e) Start and run valves clear—will be revealed when examining for (c) and (d), or can be tested by disconnecting at point 19.

If the burner is satisfactory in all the above respects, but still operates badly, examine, clean out and, if necessary, replace the boiler tubes—*see* paras. 6 (f) and 6 (g).

Remember the boiler tubes *must be hot* before the burner will operate on "Run" valve 21A. Do not switch over from "start" to "run" until the hexagon plugs on the back of the burner are really hot. After a shut-down, however short, start up again on air.

BURNER UNIT, HYDRA, S.B., TYPE E.

1. General description. (See Plate 5.)

The Burner Unit works in the same way as a "Primus" stove or ordinary blow-lamp, having a fuel tank which is under pressure; a length of tube through which the fuel passes on its way to the jet and in which it is vaporized by the heat of the flame; and a "burner jet" from which the vapour emerges to be burnt.

The fuel tank is put under air-pressure with a foot pump. On the air connection of the tank is an "air valve," which must be opened when pumping and closed when pumping stops.

The quantity of fuel passing to the jet is regulated by a "control tap," operated by a handwheel at the rear of the tank. The assembly of vaporizing tubes and jet is the "burner body." The fuel from the control tap enters the burner body at the "feed stud boss" in the rear end of the lower or "fuel tube," passes up this tube and round the ring or "vaporizing tube," then down the upper or "gas tube" to the "jet boss." The latter contains the jet, which can be removed after undoing the "gas plug" which seals the end of the jet boss.

A "tank insulating panel" screens the fuel tank from the burner body.

The flame is directed into the furnace opening by a cast-iron "flame ring," which surrounds the vaporizing tube of the burner body. The flame ring protrudes through the "burner-insulating panel," which is a part of the "frame" on which tank, lifting handle and burner body are fixed. The burner insulating panel is intended to prevent cold air from entering the furnace outside the flame ring, and should therefore be placed hard up to the furnace opening.

The complete outfit of Burner Unit (empty), with tools and cover, weighs about 65 lb. The fuel used is petrol, and the consumption $\frac{7}{8}$ to 1 gallon per hour at full control tap opening. The fuel tank holds 2 gallons.

2. Remember that any petrol-burning appliance is a constant source of danger.

With this apparatus the following points must be constantly watched :—

- (a) *Filling*.—Never fill or open up the tank anywhere near a naked flame; allow no smoking when filling is in progress; do not re-light burner until petrol cans or other appliances have been removed to a safe distance; do not spill petrol.

- (b) *When in use.*—Always light the burner and get it going well BEFORE putting it to the disinfector fire-tube opening.

If the flame goes out when the burner is in position with the disinfector, REMOVE the burner AT ONCE, otherwise liquid petrol will be injected into the fire-tube and will vaporize there, and an explosion may follow when the burner is re-lit.

- (c) *Petrol fire.*—Never try to put a petrol fire out with water. Use chemical extinguisher, sand, earth or damp sacks.

3. Preparing Burner Unit for use, and lighting up.

(a) See that the petrol control tap is closed and the foot pump disconnected, and open air valve to ensure that the tank is not under pressure and as an air-vent when filling.

(b) Then remove filler cap and fill the tank up to within 3 inches of the top with CLEAN petrol, preferably of the cheaper and less volatile grades. Replace filler cap and tighten.

(c) Connect up the foot pump, with air valve still open, and pump up till the gauge registers 20 lb. per square inch (or to lowest "cooking pressure," as shown on pressure gauge dials which are not marked in lb. per square inch): Then close air valve.

(d) With Burner Unit at a safe distance from petrol cans, etc., and from disinfector, open the petrol control tap. As soon as petrol issues from the jet close the control tap again, and then light the petrol. Keep the burner alight by alternately opening and closing the control tap, avoiding excessive flaring. When the petrol vapour flame appears, slowly open the control tap to full open (half a turn). Then open the air valve and pump up to 50 lb. pressure (or to the higher range of "cooking pressure" on dials so marked). Close air valve.

4. Use with disinfector.

(a) As soon as a constant blue flame appears, put the Burner Unit with its nozzle directed into the disinfector fire-tube, and with the burner insulating panel hard up to the disinfector body. Keep the flame at a steady intensity, re-pumping at short intervals to keep the pressure up, and adjusting the control tap as necessary. If surging of the flame occurs the control tap is too fully open.

(b) A *yellow* flame may be caused by :—

(1) Pressure too high (this also causes excessive carbon deposit in burner body).

(2) Jet partially blocked, giving a "crooked" flame.

(c) If the flame goes out, remove the Burner Unit AT ONCE.

(d) The flame going out may be due to a choked jet.

(e) Never pump up to beyond the red line on the gauge, or beyond the limit of "normal cooking pressure" on dials so marked.

(f) Always get the spare Burner Unit lit and burning properly before the unit in use runs out of petrol, so as to make an instantaneous change-over. It is best to change over *before* the petrol runs dry.

(g) A strong wind will interfere with the flame. Plate 5 shows a device for shielding the flame which is strongly recommended to be provided. It can be made up in a few minutes.

5. Extinguishing.

Take the Burner Unit away from the disinfector. Close the petrol control tap. When the flame and smouldering particles have burned out, AND NOT BEFORE, disconnect the pump and open the air valve. When all pressure in the tank is released, close air valve again.

6. Maintenance.

(a) Always use *clean* fuel.

(b) See that *no water* enters the fuel tank. Periodically empty the tank and swill out with a little clean fuel. A drain plug is fitted in the base of the tank. During this operation (and at all other material times) remember that a very little vapour, mixed with a much greater quantity of air, forms an explosive mixture.

(c) Clean the jet with the burner pricker (in tool kit). If this fails the burner body must be dismantled, tapped to remove loose pieces, and blown through. *Badly* carbonized tubes can sometimes be cleaned by heating to red heat (after removing gas plug, jet and feed stud) and quenching out in cold water, which may loosen the deposit. Tapping and blowing through follow, of course. Leave no loose pieces in the tubes.

(d) Obstruction in the jet may sometimes be due to metallic deposit from "leaded" fuels. If lead deposit adheres to the

inside of the jet its removal is very difficult, and it is best to scrap and replace. If it is deposited as a small detached particle its removal is easy.

It is possible that a "self-cleaning" jet may be evolved to overcome the deposition of lead from such fuels. Meanwhile, their use must involve increased attention by the operator.

(e) The burner body has a normal life of 1,000 hours, and is then scrapped and replaced.

A spare burner body is provided with each Type E Burner Unit, and is carried inside the cover.

(f) The tank should, if possible, be hydraulically tested with 100 to 120 lb. pressure every 12 months.

7. Type D Burner Units.

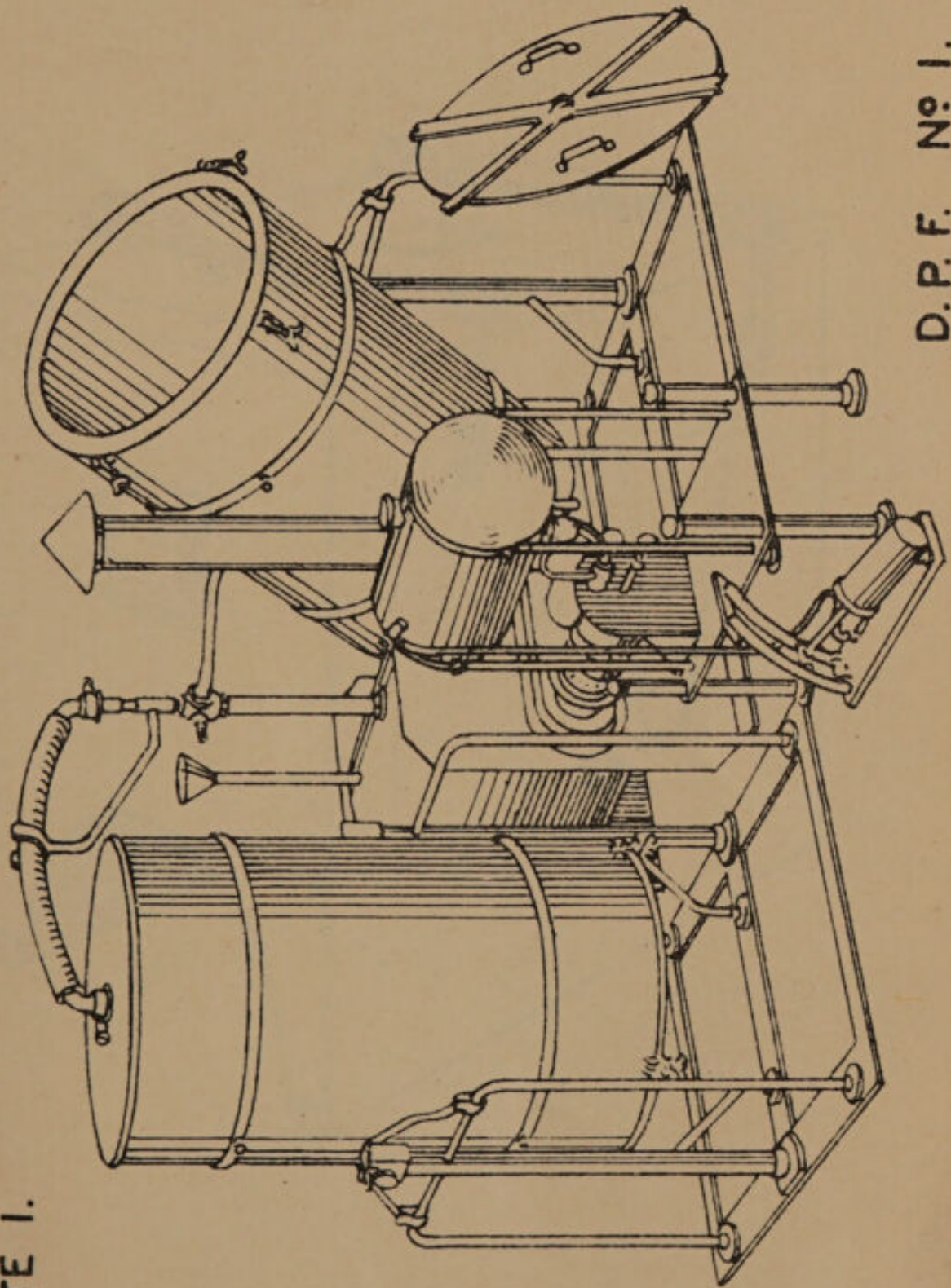
The previous model to the Type E, namely, the Type D, may be encountered. This has a *bronze* burner body, consisting of two pairs of Y-shaped tubes which are connected at the forward ends by cross tubes. These require decarbonizing every 30 hours of burning. Decarbonization of these bronze burner bodies is done as follows:—

- (a) Turn off the fuel. Unscrew tank from frame and slide it back to allow tank and burner body to come away from burner insulating panel. Remove flame ring.
- (b) Unscrew feed stud connecting burner body to tank. Remove burner body.
- (c) Unscrew gas plug at base of burner body and remove jet.
- (d) Unscrew the four plugs at the ends of the cross-tubes.
- (e) Insert the small reamer (from the tool kit) into each cross-tube and rotate until free.
- (f) Insert the large reamer into each of the Y tubes and rotate until free.
- (g) Tap all tubes lightly to remove loose pieces, and finally blow through the tubes.
- (h) Re-assemble, ensuring the jet is in place before the gas plug is screwed in.

8. Storage.

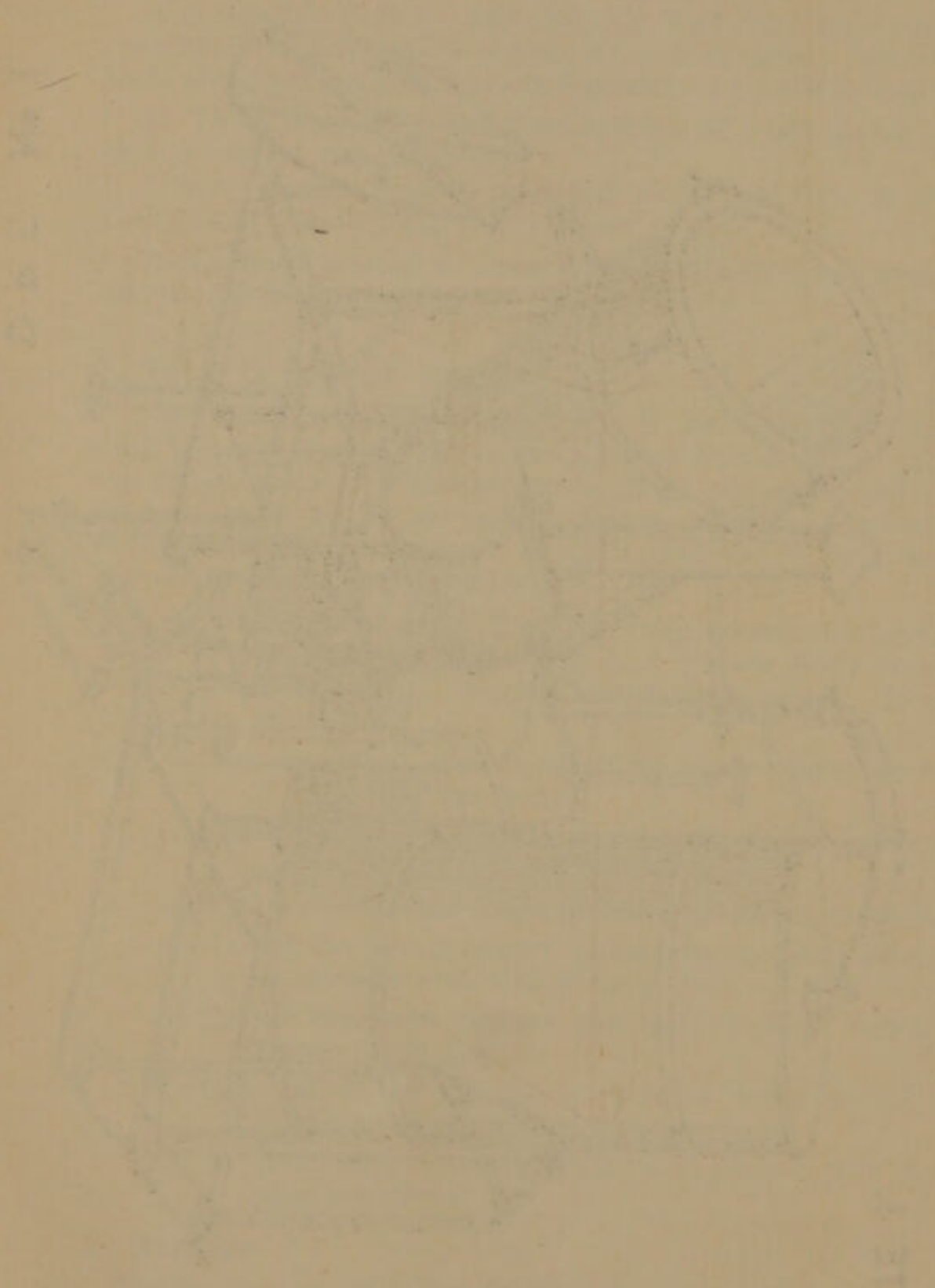
Before storage clean out tubes, jet and tank, and then close both control tap and air valve.

PLATE I.



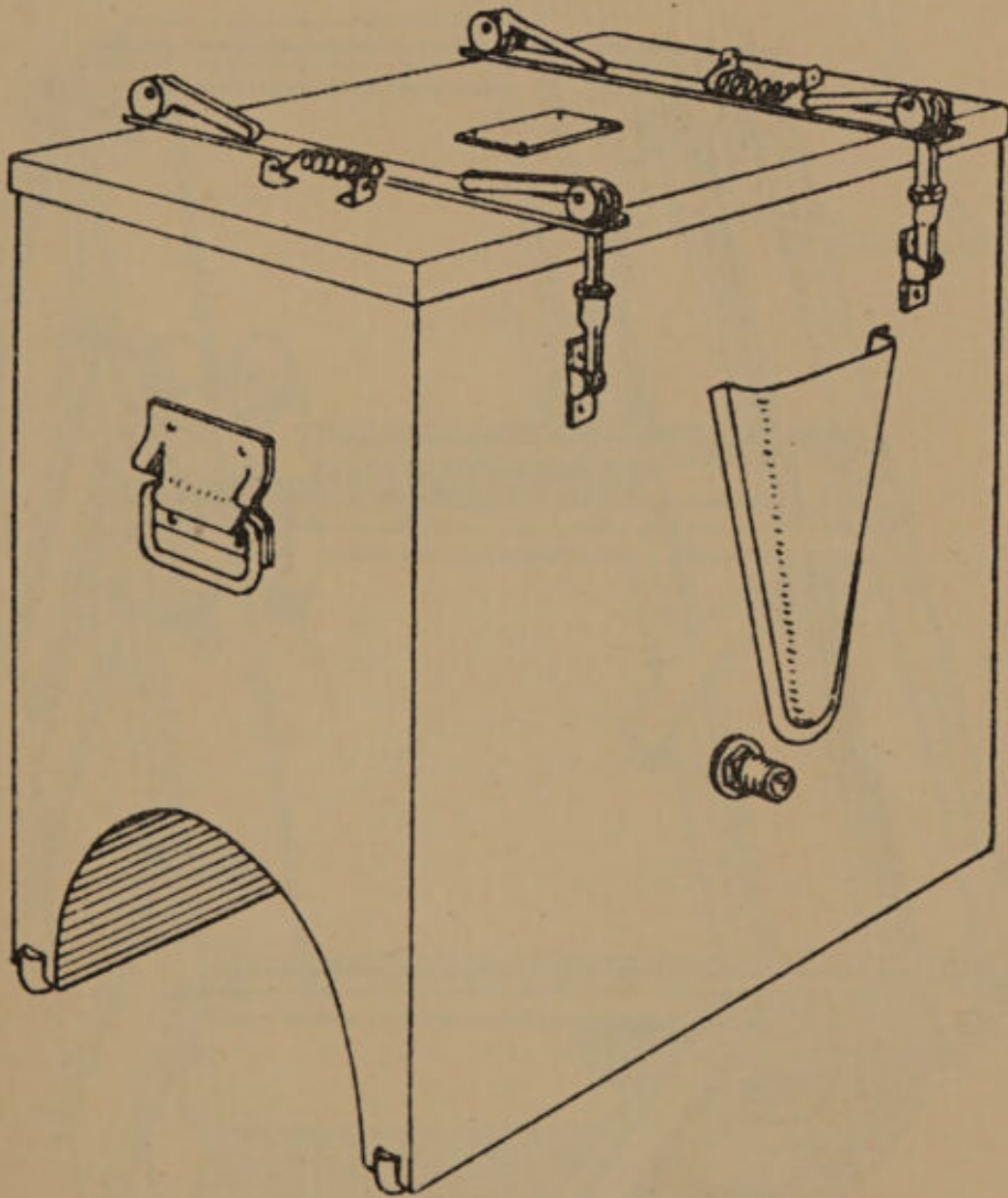
D. P. F. No 1.

200



21A/4

PLATE 2.



D. P. F. No 2.

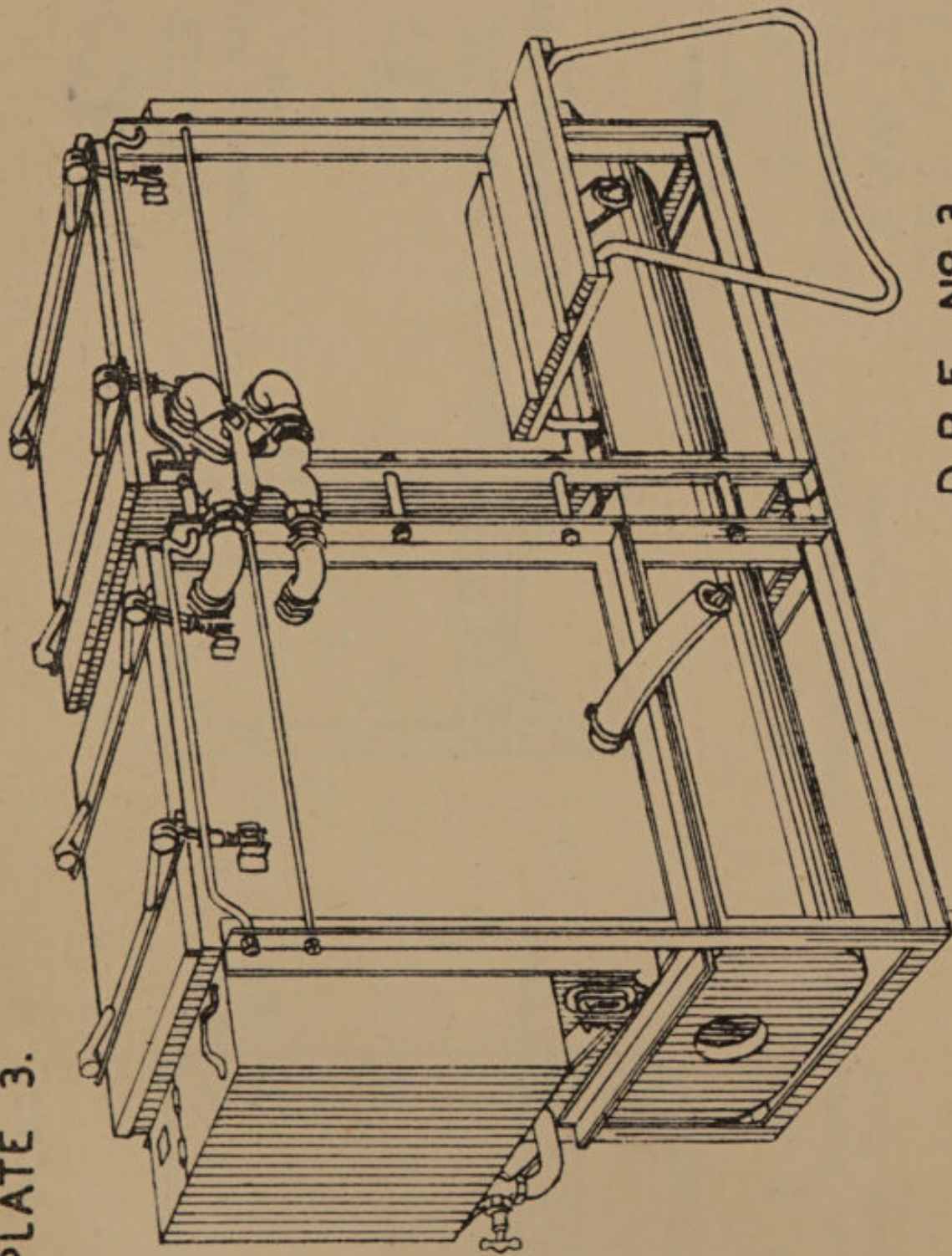
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5 37A 19

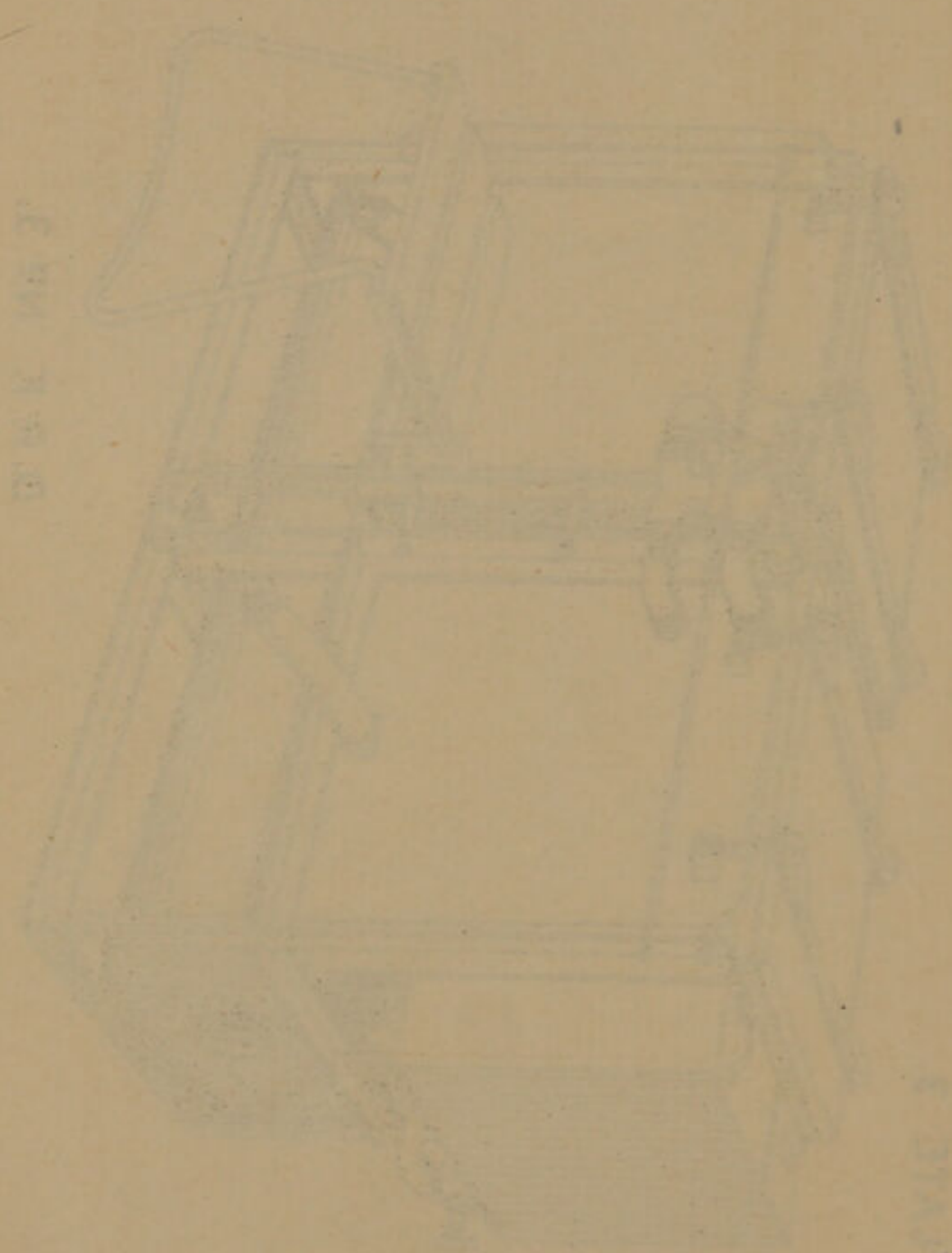
PLATE 3.

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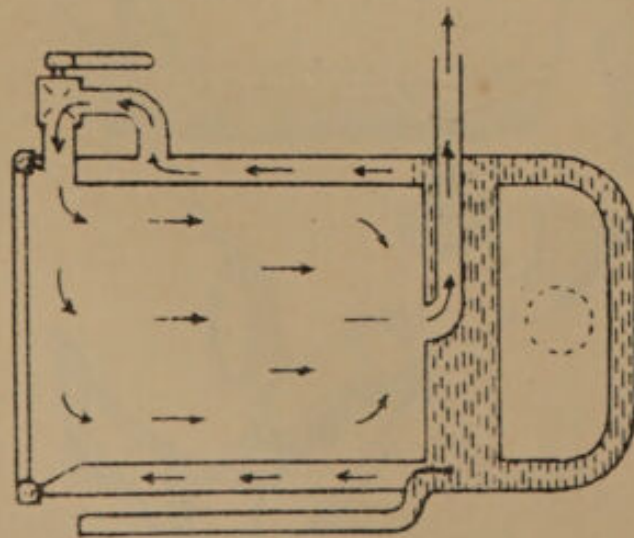
D.P.F. No 3.

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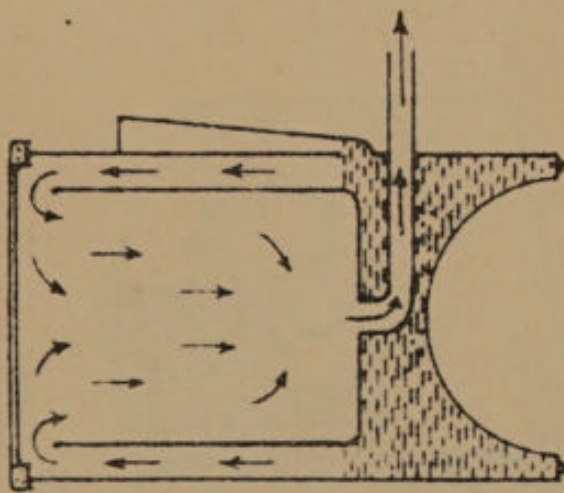


1841

PLATE 4.



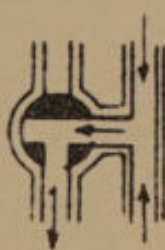
D. P. F. No 3.
 DIAGRAM SHOWING
 STEAM FLOW.



D. P. F. No 2.
 DIAGRAM SHOWING
 STEAM FLOW.



① HANDLE POINTING
 RIGHT.



② HANDLE POINTING
 LEFT.



③ HANDLE CENTRAL.
 3 WAY COCK
 D.P.F. No 3.

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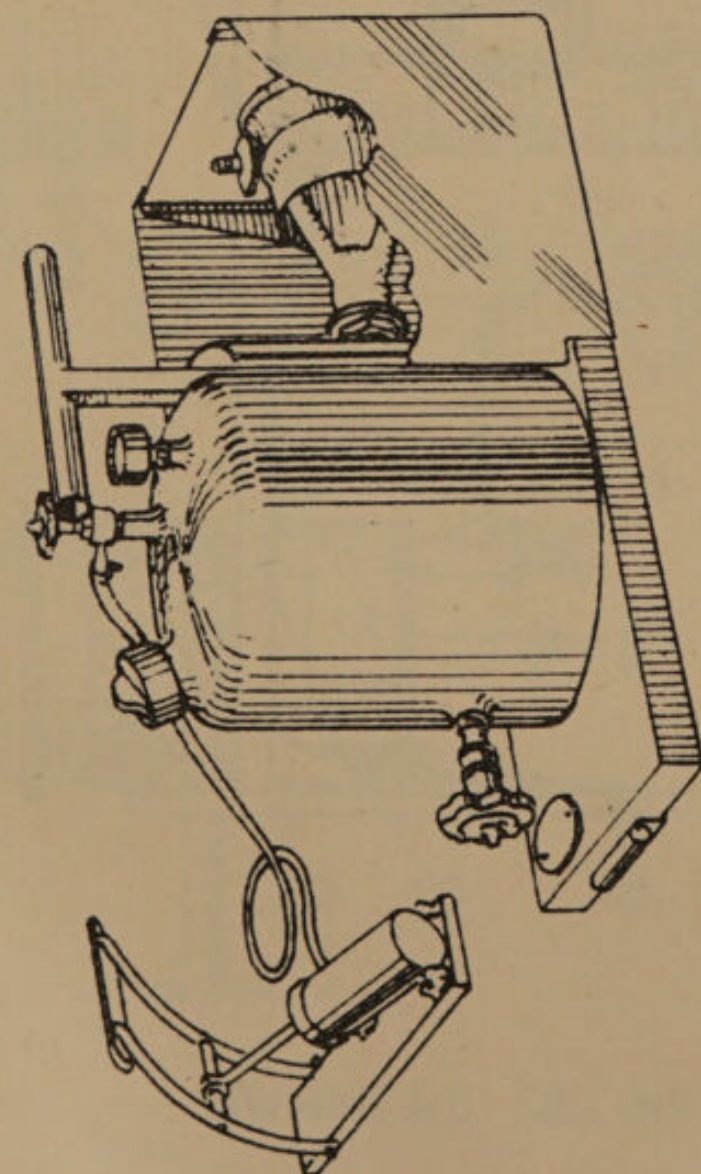
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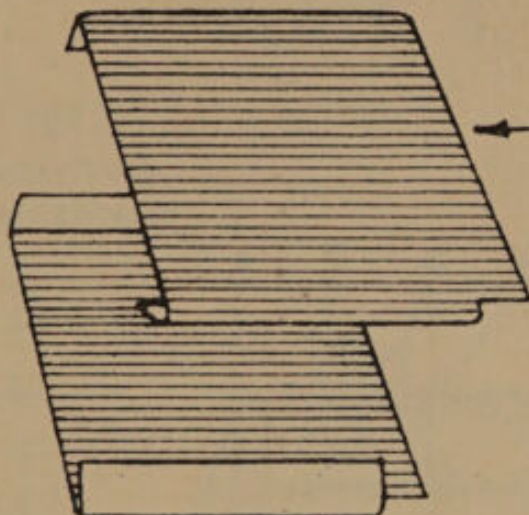
1000 1000

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PLATE 5.

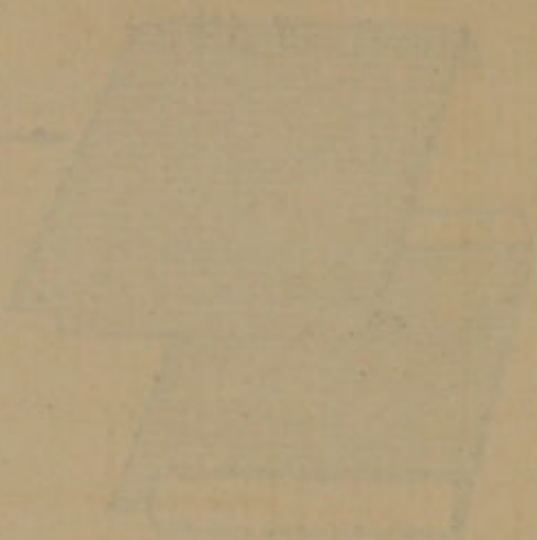


BURNER UNIT HYDRA TYPE "E"



IMPROVISED
WIND SHIELD
TO BE MADE
LOCALLY FROM
BISCUIT TINS
OR SIMILAR
MATERIAL

COPIED FROM
CLARK'S DIARY
MAY 18 18
MOUNTAIN VIEW
SOUTH 4000
EAST 1000
WEST 1000

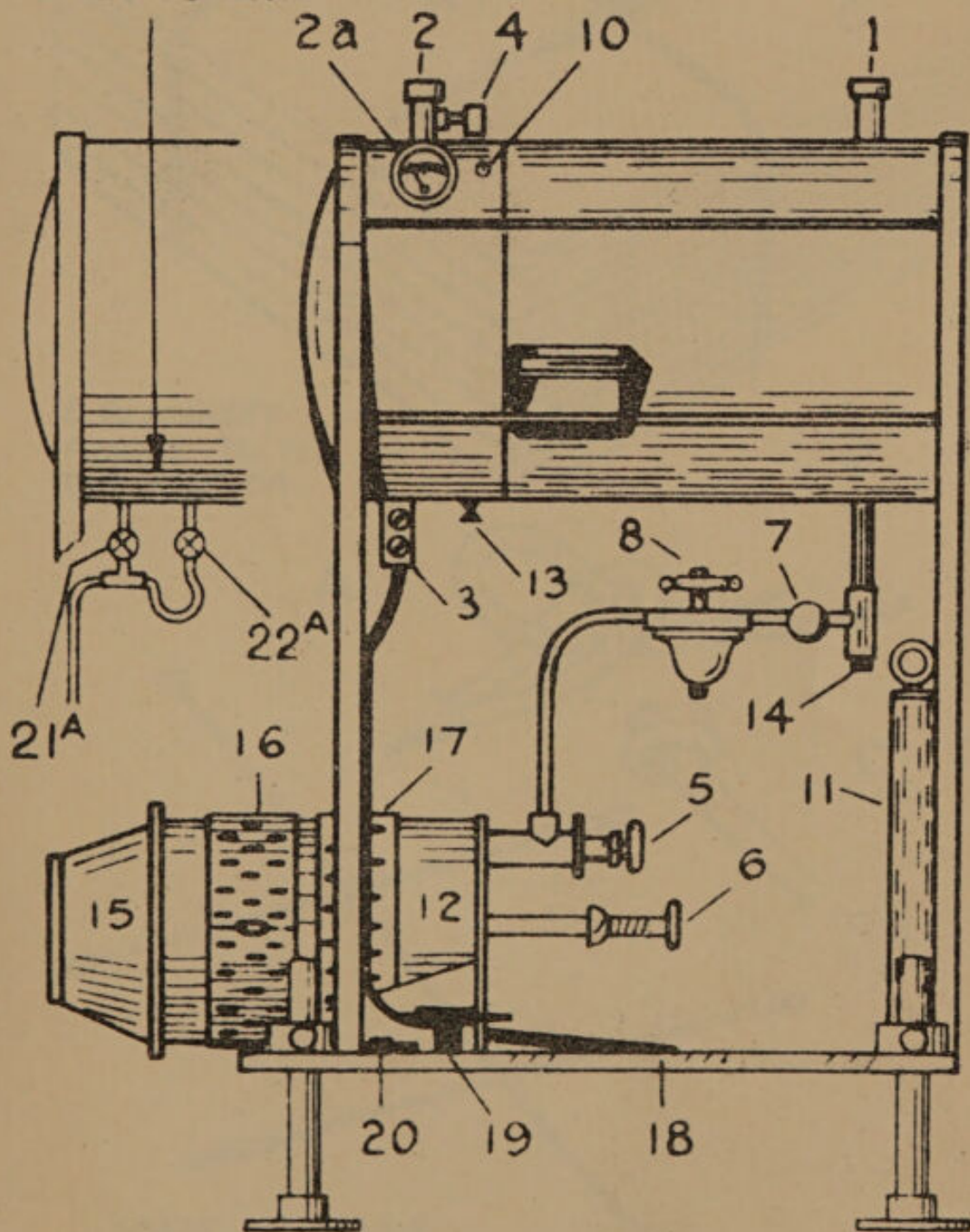


2 1000 1000 1000 1000

2 1000 1000

PLATE 6.

PART N°3
ALTERNATIVE
ARRANGEMENT



BURNERS OIL N° 1.

PLATE 3

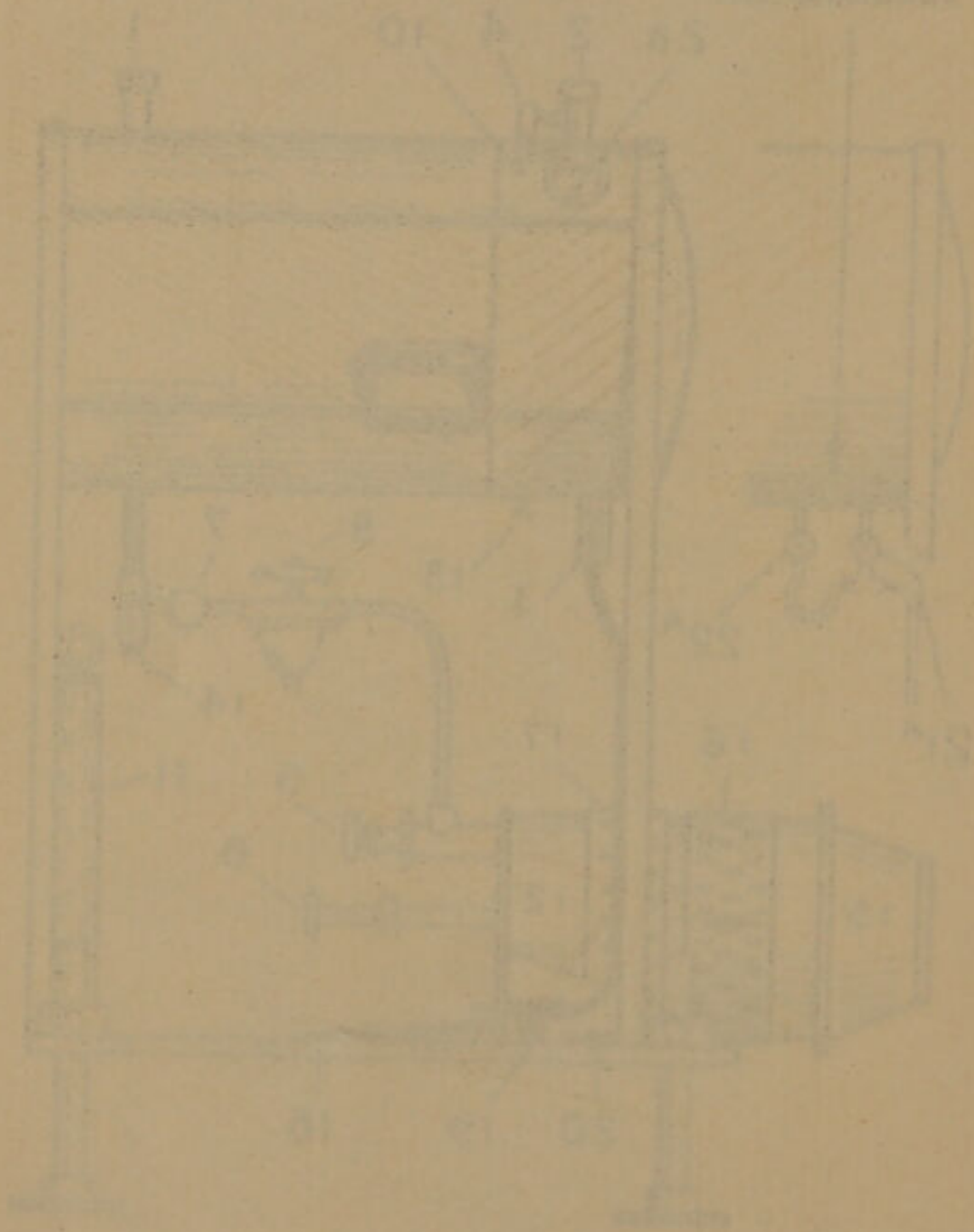
PLATE 3

PART 10

EXPLANATION

THESE FIGURES

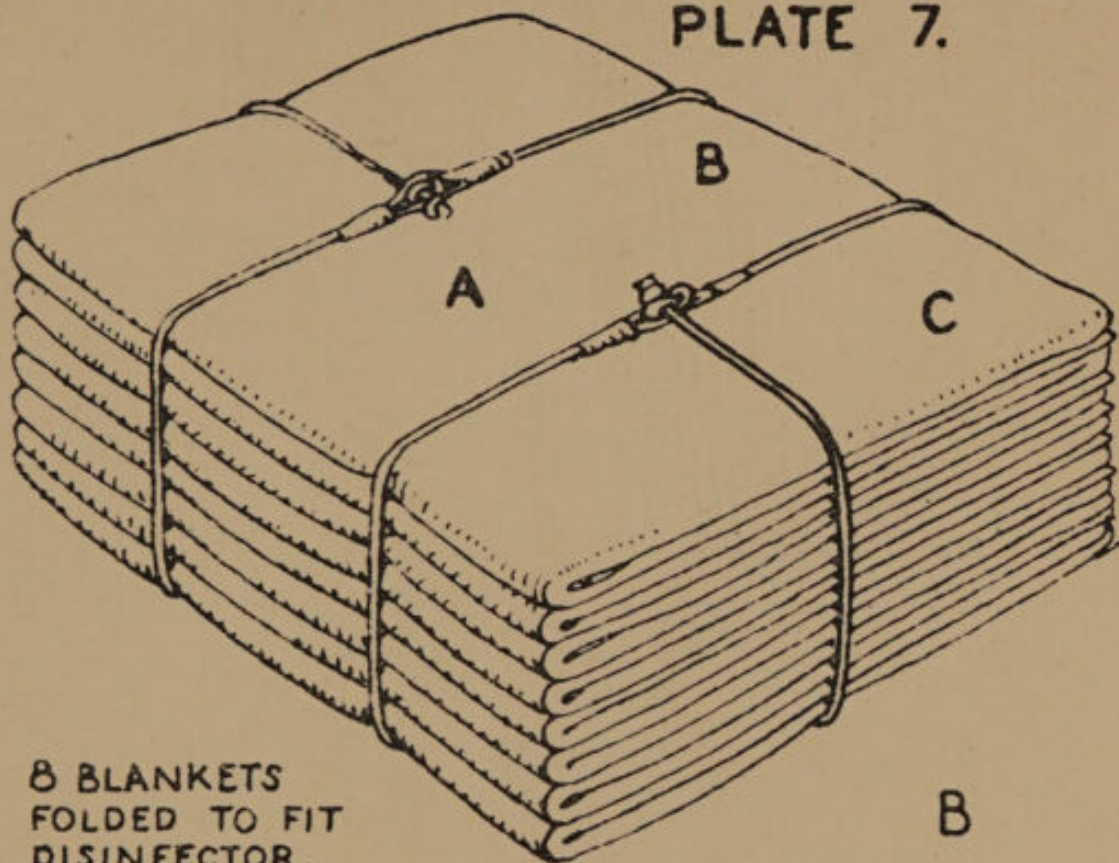
OF A S S



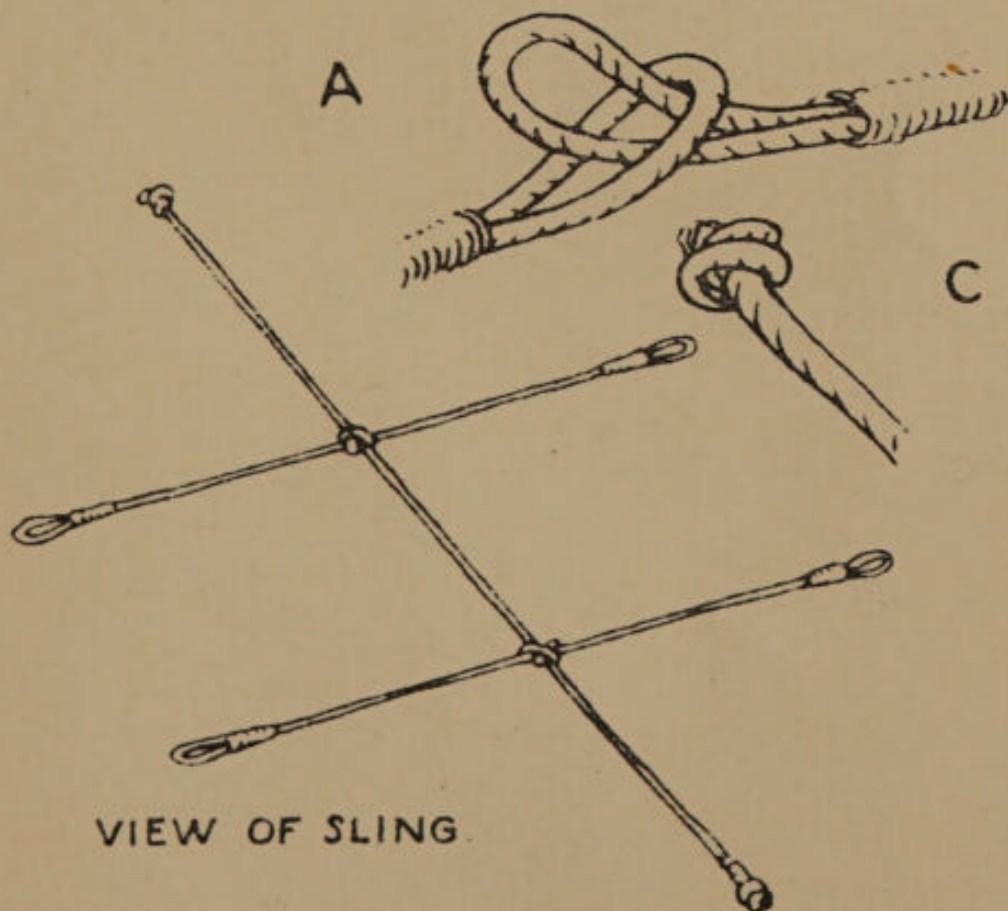
OF A S S

BURNING OF THE

PLATE 7.



8 BLANKETS
FOLDED TO FIT
DISINFECTOR.



METHOD OF TYING BLANKETS FOR USE
IN D. P. F. No 3.

