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AIR RAID PRECAUTIONS

HANDBOOK No. 1

(1st Edition)

PERSONAL PROTECTION AGAINST GAS

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1937
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In addition to these Handbooks, there is being published a series of A.R.P. Memoranda dealing with various aspects of the organization to be provided by local authorities for public air raid precautions services.

GENERAL PREFACE.

The series of Air Raid Precautions Handbooks (of which a list is given on the opposite page) is produced, under the authority of the Secretary of State, by the Air Raid Precautions Department of the Home Office with the assistance of other Government Departments concerned.

The measures for safeguarding the civil population against the effects of air attack which these Handbooks describe have become a necessary part of the defensive organisation of any country which is open to air attack. The need for them is not related to any belief that war is imminent. It arises from the fact that the risk of attack from the air, however remote it may be, is a risk that cannot be ignored, and because preparations to minimise the consequences of attack from the air cannot be improvised on the spur of the moment but must be made, if they are to be effective, in time of peace.

For the purpose of the measures now to be taken, it must be assumed that the scale of attack would greatly exceed anything which was experienced in the last war, and would involve the use of high explosive and incendiary bombs.

The use of poison gas in war is forbidden by the Geneva Gas Protocol of 1925, to which this country and all the most important countries of western Europe are parties, and the Government would use every endeavour on an outbreak of war to secure an undertaking from the enemy not to use poison gas. Nevertheless, the risk of poison gas being used remains a possibility and cannot be disregarded.

The Handbooks are designed to describe a scheme of precautions which it is hoped would prove effective in preventing avoidable injury and loss of life, or widespread dislocation of national activities. The Handbooks will aim at giving the best available information on methods of passive defence against air attack, and will be revised from time to time in the light of future developments.

CONTENTS

LIST OF ILLUSTRATIONS.

GLOSSARY OF TECHNICAL TERMS.

Air Lock	A compartment or lobby at the entrance to a gas protected room or shelter which enables persons to pass in and out without admitting gas.
Anti-Dim Outfit ...	The materials provided for treating glass eyepieces of respirators so as to prevent dimming by moisture.
Bleaching Powder ...	Chloride of lime.
Concentration	The proportion of gas in a given volume of air.
Container	The part of the respirator containing the filter and the gas absorbent.
Contamination	The liquid or vapour remaining on an object or person as a result of exposure to gas (usually a persistent gas).
Decontamination ...	A process intended to remove the contaminating gas or to render it harmless.
Facepiece	The part of a respirator which covers the face.
Gas	Includes any chemical substance, solid, liquid or gas, used in war for its poisonous or irritant effects on the human body.

Non-persistent gas	...	A gas which forms a cloud (not necessarily visible) immediately it is released and leaves no liquid contamination on the ground.
Persistent gas ...	...	A gas in liquid form which evaporates slowly and so continues to give off dangerous vapour for a long period.
Respirator	... ...	An apparatus designed to protect the eyes and lungs from gas.
Sensitivity	... ...	The ease with which a person is affected by gas.

INTRODUCTION.

The greater part of the contents of this handbook was included in the first edition of A.R.P. Handbook No. 2, but this handbook is now issued separately because it concerns a much wider range of persons than the first aid services for whom Handbook No. 2 is primarily intended.

Knowledge about personal protection against gas, both individual and collective, will be of vital importance to members of all air raid precautions services, and to every one whose duties might involve working or remaining in a gas concentration. The information contained in this handbook is intended to give not only rules of protection but also a general knowledge of the nature and dangers of war gases.

A very great responsibility rests upon the members of all air raid precautions services to set an example of quiet courage and cool resourcefulness in emergency, and this can only be obtained by careful training and a clear appreciation of all the facts.

A short glossary of technical terms has been included at the beginning of this book, which the reader is advised to study before proceeding with the chapters which follow.

CHAPTER I.

THE NATURE AND PROPERTIES OF WAR GASES.

1. What is meant by "gas."

By the term "gas" in warfare is meant any chemical substance, whether solid, liquid or vapour, which is used because it produces poisonous or irritant effects on the human body.

Such substances are generally liberated in the air as vapours or irritant smokes. They mix with the air and produce their harmful effects upon any unprotected persons who are exposed to this atmosphere. In the case of certain of the chemical substances, such as mustard gas, a serious effect is also caused by direct contact of the human body with the liquid itself or with objects which have become contaminated by the liquid.

For convenience it is usual to divide gases into two main groups:—

(*a*) Non-persistent.
(*b*) Persistent.

When liberated into the air, "non-persistent" gases form clouds of gas or smoke which drift along with the wind, gradually mixing with larger quantities of air and so becoming less dangerous. Examples of such substances are chlorine, phosgene and the irritant smokes produced from certain compounds of arsenic.

"Persistent gases" are usually liquids which evaporate slowly, giving off dangerous vapour. The ground and any other object on which the liquid has fallen will continue to give off vapour until the liquid has all evaporated, or until steps have been taken to render it ineffective.

In the case of mustard gas or other blister gases, contact with the contaminated ground or objects will give rise to skin burns until decontamination has been effected. Even walking over contaminated ground is dangerous and must be avoided.

Mustard gas and many of the tear gases are examples of this persistent class.

In an air raid, the essential difference between the "non-persistent" gases and the "persistent" gases would be that a bomb containing the former would produce a cloud of gas which would be carried away by the wind, whereas a bomb containing the latter would spatter liquid around the point of burst, and the affected ground would require special treatment ("decontamination") to render it safe.

2. Effect of Weather.

The effectiveness of a "gas" may be considerably influenced by the weather. A high wind rapidly blows away non-persistent gas or vapour arising from an area contaminated by persistent gas, but it does not remove the danger which results from touching objects or ground contaminated by the latter.

In warm weather, persistent liquids will give off vapour which will rise and readily become mixed with the surrounding air, but on the other hand the liquid will evaporate more quickly than in cold weather. Consequently, under warm weather conditions the danger from vapour will be greater. Frosty weather has little effect upon the clouds of non-persistent gases, but liquids such as mustard gas may freeze under cold conditions. In the frozen state, direct contact will still produce skin burns, but there is less danger from vapour. When it thaws, the liquid will again begin to give off vapour.

Light rain has little effect upon gases of either class, but heavy rain tends to wash gas out of the air and also helps to wash away and destroy any liquid upon the ground. The most dangerous conditions under which any gas may be used are in mild calm weather, with or without fog. The absence of wind means that the rate of mixing of the gas with air will be slow, and therefore the gas will drift about in

dangerous concentrations for a long time. Under these conditions gas may slowly penetrate into buildings through small inlets which have been overlooked.

3. Effects produced by Gas on Personnel.

The division of gases into two main groups—non-persistent and persistent—is convenient because, as soon as the class of a gas has been determined, it is possible to decide whether or not the area in which the gas has been liberated requires special treatment. In addition they may be classified according to the effects which they produce upon the human body. These groups are designated by the following names:—

(*a*) Lung irritant gas.
(*b*) Nose irritant gas.
(*c*) Tear gas.
(*d*) Blister gas.

(a) *Lung irritant gas.*—An irritant gas which attacks the breathing passages and lungs. Chlorine and phosgene are examples of this type, and will produce death if breathed in sufficiently large quantities.

These gases are sometimes called "choking gases".

(b) *Nose irritant gas.*—Irritant smokes produced from certain arsenical compounds are in this class, but though they produce intense pain in the nose, throat and breathing passages during exposure to the gas, these painful effects soon pass off in fresh air.

(c) *Tear gas.*—Any eye irritant which even in very small amounts has an immediate effect upon the eyes, causing intense smarting and a profuse flow of tears which generally make it very difficult to see. In pure air the effects soon pass off, and no damage is caused to the eyes.

These gases are often called "lachrymators".

(d) *Blister gases.*—These substances, of which mustard gas is a typical example, cause intense irritation or burning of the skin according to the amount

of gas which has come into contact with the affected part. In severe cases deep and extensive blisters may be caused.

These gases are known as " vesicants ".

No immediate pain is felt on contact with the solid, liquid or vapour, but the effects become apparent a few hours later.

Mustard gas also attacks the eyes and lungs, but in these cases also there is considerable delay before the symptoms are noticed, and it is this absence of immediate effect which constitutes one of the greatest dangers of mustard gas. The need for protection is not appreciated until too late.

The effects produced by any war gas depend on the amount of the gas and the length of time a person is exposed to it. The stronger the gas, the greater will be the injury produced in a given time. It should not, however, be assumed that small quantities of gas will always cause injury. In the case of gases which injure the lungs, a certain quantity must be breathed before it will do any real harm. A person working hard is breathing a much greater volume of air than a person sitting still, so that, if both were exposed to the same concentration of gas, the person working hard would suffer the greater injury. Only under exceptional conditions is there likely to be sufficient gas present in the air to render one or two breaths dangerous.

4. Types of the more important Gases.

The methods by which these gases may be detected are more fully described in Chapter III.

(a) Lung irritant gases.

(*i*) *Chlorine* (*Non-persistent*).—This substance has an unpleasant suffocating smell, and, when undiluted, has a greenish yellow colour. It is readily liquefied at ordinary temperatures, by the application of pressure, and is therefore usually stored in steel cylinders. It attacks most metals and is soluble in water.

Chlorine is a powerful irritant of the respiratory organs. Exposure to the gas causes a burning sensation in the eyes, nose and throat, which may be followed by bronchitis and pneumonia. Prolonged breathing of high concentrations of the gas will cause death.

(*ii*) *Phosgene* (*Non-persistent*).—This compound is a colourless gas at ordinary temperatures, though when liberated as a cloud it sometimes has a whitish appearance owing to condensation of water vapour present in the air. At low temperatures it forms a colourless liquid, and is stored in this form. It has a pungent odour rather like musty hay and is liable to cause coughing. In addition to being a very powerful lung irritant, phosgene is also a tear gas. It attacks the air cells of the lungs which, in severe cases, gradually become filled with inflammatory fluid resulting in interference with the passage of oxygen into the blood. In this state exertion will cause the patient to collapse from want of oxygen, and death is frequently the result.

There is frequently a period of " well being " between the initial effects caused by exposure to phosgene and the appearance of the more serious symptoms. This is the meaning of the so-called " delayed action " of phosgene.

(b) Nose irritant gases.

Diphenylchloroarsine (*D.A.*) *and similar compounds* (*Non-persistent*).—These arsenical substances can be liberated into the air as smokes, which, like tobacco smoke, really consist of very minute particles rather than actual gas or vapour. Quite small quantities of the " gas," which are invisible to the eye, will produce intense irritation and pain in the nose and throat, which are often accompanied by sneezing. The first effect noticed is irritation of the nose and throat. This is followed by a burning sensation in the

chest, headache, and aching in the teeth and gums. These effects are, however, of a temporary nature and no permanent injury results.

High concentrations of these gases produce irritation of the eyes, in addition to the previously mentioned symptoms in more severe form.

(c) Tear gases.

(*i*) *Chloracetophenone* (*C.A.P.*) (*Non-persistent*).—This substance is a white crystalline solid which vaporizes when heated. The cloud so produced is intensely tear-producing. In high concentrations the gas has an irritating effect upon the exposed skin.

(*ii*) *Ethyl idoacetate* (*K.S.K.*) (*Persistent*).—This compound when pure is a colourless oily liquid with a pungent smell like peardrops. The liquid as used however is generally dark in colour. It evaporates slowly at ordinary temperatures; when spattered upon the ground the lachrymatory effects of the vapour persist for some hours.

It is a strong tear gas, and in high concentrations a respiratory irritant.

(*iii*) *Bromobenzyl cyanide* (*B.B.C.*) (*Persistent*).—This substance as generally used is a brown liquid with a very penetrating smell. The effect of the vapour on the eyes is not quite as intense as that of the previous compound, but the liquid is much more persistent. Under suitable weather conditions the lachrymatory effect may be noticed several days after contamination with this liquid.

(d) Blister gases.

(*i*) *Mustard gas* (*Persistent*).—This substance is an oily liquid with a faint but characteristic smell. Some people consider this smell like mustard, others

associate it with horse-radish, onions, or garlic. Some persons cannot detect the smell except in high concentrations.

It is readily soluble in certain liquids such as benzene and methylated spirits, and also in tar and fat. Owing to its solubility in fat, it is quickly absorbed by the skin with subsequent injurious results. Similarly it is readily absorbed in the tar surface of roads.

It evaporates slowly at ordinary temperatures and is very persistent. It is a powerful irritant, and this effect can be caused by either the vapour or the liquid. Naturally the liquid is more effective than the vapour.

Mustard gas differs from the gases previously dealt with since it may be dangerous in a number of ways. The principal sources of danger are given below:—

(i) When the ground or other objects have been splashed with liquid mustard, vapour is given off which may injure the eyes, the lungs or exposed parts of the body.

(ii) The vapour may also be absorbed by clothing and gradually penetrate to the skin, causing burns even after the wearer has moved out of the dangerous area.

(iii) If the contaminated ground or splashed objects are touched with the hand or other parts of the body, burns will be caused, unless immediate precautions are taken. Again, if the clothing rubs against anything which is contaminated, the liquid will be soaked up and the clothing may produce blisters. It also has to be remembered that whenever a person has become contaminated he is a source of danger to everyone with whom he comes into contact. If he gets mustard gas on his boots and goes into a room containing a number of other people, they may all be seriously affected by the vapour coming from the boots. Danger arises from the fact that the only means of appreciating the

presence of mustard gas is by the sense of smell and that the smell of the gas may easily pass unnoticed or be confused with other smells.

(iv) Persons may become contaminated by drops of mustard gas which have been released from aircraft in the form of a spray.

Neither the liquid nor the vapour produces any immediate recognizable sensation or effect. The symptoms do not become apparent for from two to eight hours afterwards, by which time it is too late to prevent injury. If a person is known to have been exposed to mustard gas vapour or contaminated by liquid and steps are taken to apply preventive measures quickly, injury may be avoided or at any rate much reduced.

The eyes are the part of the body most liable to be affected by mustard gas. To remain unprotected in an atmosphere containing even a small amount of mustard gas vapour for an hour will cause acute inflammation of the eyes. If more mustard gas is present a much shorter exposure will be injurious. Mustard gas vapour will also affect the respiratory system. Bronchitis or worse injury may result according to the quantity of mustard gas present and the time of exposure.

Both the vapour and the liquid will cause burns of the skin. An hour's exposure to even a small quantity of vapour will produce, after the usual delay period, a reddening and scalding of the exposed parts of the body, while high concentrations of vapour will produce blisters.

Serious damage may also result from the continued wearing of clothing which has been exposed to mustard gas vapour.

The effects of the liquid are, of course, far more severe than those of the vapour. Liquid contamination of the skin must be treated at once.

(*ii*) *Lewisite* (*Persistent*).—This gas differs from mustard gas in that—

(*a*) it contains arsenic,

(*b*) it has a strong smell like that of geraniums,

(*c*) it is noticed at once owing to irritation of the eyes and nose, and

(*d*) it acts more rapidly than mustard gas.

Otherwise its characteristics and effects are generally similar to those of mustard gas.

CHAPTER II.

THE METHODS OF GAS ATTACK FROM THE AIR.

5. Bombs from Aircraft.

Air bombs are particularly suitable for charging with gas because they do not have to withstand the shock of discharge from a gun. For this reason the steel casings can be much thinner than in the case of shell. The quantity of gas which a bomb will hold is somewhere about half of the total weight of the bomb. In the case of a shell it is proportionately very much less.

The type of bomb used for the discharge of gas is a particularly effective weapon for the purpose because it does not bury itself deeply in the ground. Most of the gas is thus liberated on the surface, and the full effect is produced without being smothered.

Air bombs containing gas may be small or large, but the effects produced will be similar. In the case of a non-persistent gas the whole contents of the bomb will form a cloud near the point at which it strikes the ground and this cloud will drift along with the wind. The size of the cloud when first formed will be small, but the concentration of gas in it will be very great. As the cloud is swept along by the wind it will become diluted with more air, but its size will increase. After travelling a considerable distance the gas will become mixed with so much air that it will be harmless. The rate at which this process of dilution goes on will depend upon the weather conditions, particularly the strength of the wind.

In a high wind the cloud will be rapidly broken up, though gas may be forced into unexpected places by the wind pressure while the concentration is still high.

It is possible that a house which would resist the penetration of gas in calm weather might let in an appreciable quantity of gas in a strong wind. Generally speaking, however, the danger to be anticipated from a non-persistent gas will be very much reduced by high wind.

If there should be no wind at all, or only a slight drift, the worst situation will arise, though the effects will be more local. A dense cloud of gas will form at the point of burst and will remain in that particular area until it is gradually dispersed. It will find its way by diffusion and ventilation currents into areas, cellars, tunnels, etc., and once there it is not so readily cleared as the gas in the open streets. Once the gas has penetrated into a confined space it is not subject to the influence of the wind and air currents prevailing outside, and may continue to be dangerous when the outside air has become clear of gas.

It is possible that the nose irritant gases may be produced from some form of generator contained in a bomb. In this case the cloud will be emitted (for some minutes) from the place at which the bomb has fallen and the distance to which the gas will travel may be somewhat greater than with the other non-persistent gases.

A bomb containing persistent gas such as mustard gas will make a large splash of liquid at the place where the bomb dropped and will also cover a considerable area with fine droplets. The degree of contamination and the size of the area affected are dependent upon the size and type of the bomb, the nature of the ground on which it falls, and the strength of the wind. In hard ground penetration will be slight, and the liquid will be more widely distributed over the surrounding area. Again, if the wind is fairly strong, the drops formed by the shattering of the bomb may be carried down-wind for a considerable distance.

Anyone who is near the place where the bomb falls may be contaminated by the liquid drops or splashes and immediate action, as described in Chapter VI, must be taken to avoid serious injury.

Persons walking over gas-contaminated ground will be liable to contaminate their boots by stepping in liquid or picking up mud containing mustard gas. This danger will persist for a long period (usually some days), unless the area is decontaminated, and during this time the area must be railed off and all movement over it prevented.

A dangerous concentration of mustard gas vapour may also travel down-wind in exactly the same way as a cloud of non-persistent gas, though it will not usually be effective for the same distance. Unless the weather is very cold, the contaminated area will continue to give off vapour until it has been decontaminated and the recognised warning sign must be erected to warn persons of the danger from the vapour.

A bomb filled with tear gas will splash the ground in the same way as one filled with mustard gas. Evaporation of the liquid on the ground will produce a cloud of tear gas which will render a large area intolerable to persons who have no protection for their eyes. This vapour effect will continue for a number of days, or until the area is properly decontaminated.

The chief difference between the use of large and small bombs is that, for the same load, there will be in one case a few well-marked and heavily contaminated areas, and in the other case a large number of centres of contamination which might be more difficult to locate and clear.

6. Spray from Aircraft.

Mustard gas or other persistent gas can be sprayed from aircraft. The liquid falls in fine drops over a fairly wide area. The drops may indeed be so small

as not to be noticed by persons upon whom they may fall. Such a spray may be a source of very great danger, because it may fall on the face, neck, and any exposed parts of the body, in addition to the clothing, without being noticed.

Attention has been drawn to this method of releasing gas, and to the particular difficulties and risks which its use might cause, but its effectiveness must not be exaggerated. The risks to persons in the open will be obvious, but the danger may be avoided by remaining under cover.

Probably the greatest risk is from the use of a persistent gas such as mustard gas in conjunction with high explosive bombs. Material damage will be produced by the high explosive; and the mustard gas, whether used as spray or in bombs, will render the task of rescuing and treating casualties more difficult and hazardous.

CHAPTER III.

THE DETECTION OF GASES.

7. Principles of Gas Detection.

The rapid transmission of information that gas has been used, with its nature and details of the areas affected, is a very necessary factor of success in air raid precautionary measures.

By gas detection is meant the recognition of the presence of gas and the identification of its type.

The presence of gas may be detected in a number of ways:—

(i) by the smell,
(ii) by immediate irritant effects,
(iii) by visible signs,
(iv) by chemical testing.

Most gases hitherto used in warfare have either a distinctive smell or a characteristic irritant effect on the eyes, nose or throat. In many cases also there will be visible indications of gas, such as the presence of a cloud or liquid splashes on the ground.

To a large extent, therefore, reliance can be placed upon the senses, particularly the sense of smell, but chemical tests may be available in addition for the identification of particular gases.

8. Chemical Indicators.

Indicators have been devised which will assist in the identification of *liquid* blister gas and the subsequent defining of the contaminated area. The basis of these detectors consists of a special coloured yellow paint which turns red on contact with *liquid* blister gas. It is important to note that the vapour of blister gas does not give any indication on the paint. These detectors consist of two kinds:—

(i) *Detectors, Spray.*—These are indicators painted with detector paint. Their purpose is to indicate rapidly the arrival of aircraft spray.

(ii) *Detectors, Ground.*—These consist of materia painted with detector paint which, when brough into contact with a suspected contaminated sur face, will give an indication if free liquid blister gas is present.

9. Detection of the Various Types of Gas.

Detection of lung irritant gases.

Lung irritant gases are not difficult to detect as they all have a very characteristic odour. The most important example of these gases, and the one most likely to be encountered, is phosgene. This gas has a pronounced smell of musty hay. At the time this smell is detected, irritation of the breathing passages with possibly some watering of the eyes may be noticed, but should not be waited for. Phosgene forms a thin white cloud when the atmosphere is moist, otherwise it is colourless. It is non-persistent.

Detection of nose irritant gases.

Nose irritant gases are practically odourless. The first indication of their presence is likely to be irritation of the nose and throat, sneezing, etc. These gases are non-persistent.

Detection of tear gases.

Tear gases are easily detected owing to their immediate irritant effect upon the eyes. As many of the tear gases are persistent, and consist of dark brown liquids, care must be taken not to confuse gases of this group with mustard gas contamination.

Detection of blister gas.

(i) *Mustard Gas.*—The odour of this substance is not powerful, nor are the effects immediate, and consequently persons are likely to under-estimate the danger. Mustard gas, whilst the most difficult gas to

letect, can nevertheless be recognized in several ways, namely:—

(*a*) by smell,
(*b*) by visible signs,
(*c*) by testing apparatus.

The substance has a faint but characteristic smell suggestive of horseradish, onions, or garlic, but some people cannot smell it except in high concentrations. The presence of mustard gas vapour can readily be detected by a person familiar with its smell provided it is not masked by other odours, but after a short time the sense of smell becomes dulled and low concentrations of the gas may not be detected.

The liquid varies in colour from dark brown to pale straw colour. The gas given off from the liquid is invisible. The liquid, if of the pale colour, is difficult to detect on grass, trees, etc.; and it appears as a wet patch on dry roads or dry earth. On wet roads or earth it gives a slight iridescent effect, similar to that of paraffin on a wet surface. Detection of the liquid is not easy, but provided the smell is known the presence of the gas should be readily recognized.

(ii) *Lewisite.*—This substance differs from mustard gas in having a strong smell, like that of geraniums, and it is noticed at once owing to the irritation caused to the eyes and nose. Detection of lewisite should not therefore be difficult.

CHAPTER IV.

GENERAL ANTI-GAS PRECAUTIONS AND PROTECTION OF BUILDINGS AGAINST GAS.

10. How to avoid becoming a Casualty.

The risk of injury by gas will be reduced to a minimum by observance of the following rules:—

(i) Immediately on hearing an air raid warning, take cover in a gas-protected room or shelter, unless your public duty compels you to go out of doors or remain at work in an unprotected place.

(ii) Be sure you have your respirator handy in your room or shelter.

(iii) Do not come out of the room or shelter without cautiously trying to discover whether gas is about. The local gas warning will give indication of definite danger.

(iv) If your duty prevents your taking cover during a raid, always have your respirator ready to put on at once, and your protective clothing if necessary.

The air raid warning will mean that a raid may occur in a few minutes (perhaps 7 to 10 minutes). When the raiding aircraft are reported clear of the district, a further message, " Raiders Passed ", will be issued. It must be realised that this message means simply that the raiders are no longer overhead: if they have dropped gas, the danger from the gas may remain, and those who leave cover on hearing the " Raiders Passed " signal must still take precautions against the possible presence of gas.

If after a raid there is any gas in the streets, the general public should so far as possible remain under cover until the area is reported clear, that is, until the gas has dissipated or the proper steps have been taken to neutralise it.

11. Precautions for those out of doors in a gas-contaminated Area.

The duties of members of air raid precautions services may necessitate their going into streets and through areas in which dangerous concentrations of gas exist.

Contaminated areas or streets in which gas is present should be avoided if possible, and where duty makes it essential to approach a gassed area every care should be taken to avoid unnecessary contamination. Thus, it is important to keep to windward of bomb craters, and to avoid stepping on earth or débris which has been scattered about the streets, and which may be contaminated.

Whenever the presence of gas can be detected by the sense of smell, or by the effect on the eyes or throat, and whenever it is necessary to pass down-wind of craters which have been marked as dangerous from gas, the respirator must always be worn. It must not be removed until the wearer has tested the air, by inserting the fingers between the facepiece and the cheek and sniffing gently.

If these simple but fundamental precautions are observed, the efficiency of each individual will be maintained and the number of gas casualties reduced to a minimum. Any person who becomes contaminated through carelessness is temporarily unable to fulfil his duties, and at the same time is putting an unnecessary strain upon the first aid services.

Careful training in anti-gas precautions will enable a person readily to appreciate when and where danger exists, and the steps to be taken to prevent his becoming a casualty.

12. Gas Protection for Buildings.

The members of air raid precautions services will need to know how to protect buildings and rooms against gas, because they may be responsible for protecting the premises from which they would work. They should also be able, and ready, to advise members

of the general public on these matters, because every household must have its gas-protected room.

Appendix A contains guidance as to the choice of rooms for gas-protection, primarily from the point of view of the ordinary householder. It is assumed that the choice of premises to be used by air raid precautions services will usually depend on other considerations.

The methods of protecting buildings or rooms against gas, that is to say, of making them as gas-tight as possible, are fairly simple. Reliance must not be placed on glass windows. If strong paper is pasted over the glass it will prevent collapse in case the glass is cracked. If the window has shutters, these should be closed. Otherwise, if planking is available, it is advisable to board up the windows on the *outside,* as an additional protection against the effects of high explosive. The inside of the window should be covered with materials such as oilcloth, linoleum, carpet or blanket. In cases where illumination is important translucent materials such as non-inflammable celluloid, or cellophane, may be used. These should be fastened round the edges of the window frame by strips of wood or cardboard. Linen or cotton sheets, which have been backed by pasting strong paper on one side, will also prevent the penetration of gas.

A blanket or covering of one of the suggested materials should also be fastened over the outside of the door frame, leaving a flap which can be turned up to allow entrance (*see* Fig. 1). If there is a large crevice under the door, a thin strip of wood should be nailed to the floor to form a small step against which the door will fit tightly. The fireplace and any other opening through which air can enter will require to be closed by wood, cardboard or similar material. Even the keyhole should be stopped up. In many houses it will be found that the windows and doors are so ill-fitting that it is necessary to paste newspaper over the cracks to render them air tight. A mush of newspapers and water is useful for stopping up large cracks.

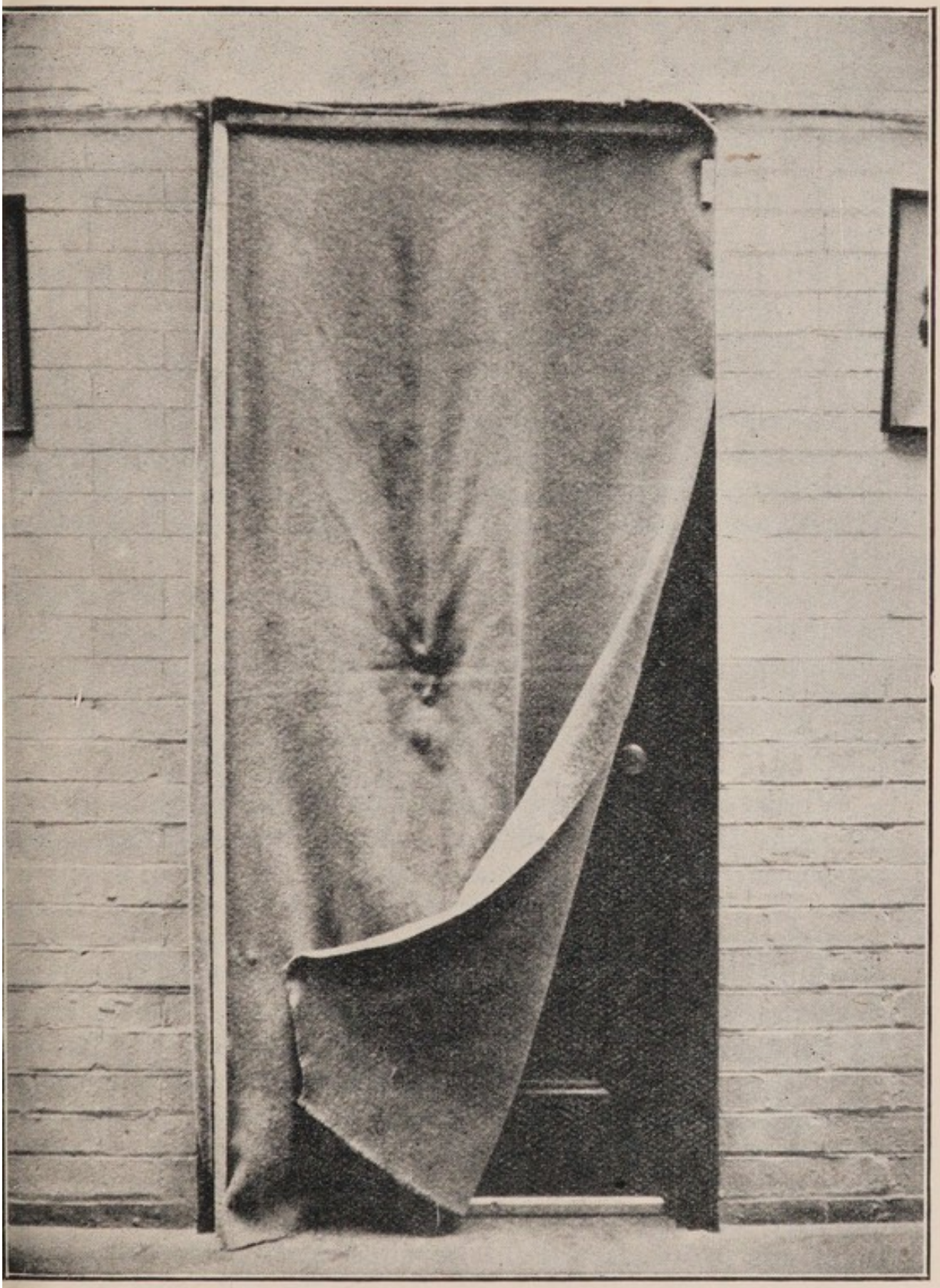

FIG. 1—GAS PROTECTED DOOR.

The full measures of gas protection which are described above may be possible only in the particular room which is to be occupied as a shelter, but it is very desirable to try to keep gas out of the whole house or building. This can be achieved to a great extent by seeing that there are no obvious means for gas to enter (broken panes of glass, open ventilators, etc.), and then keeping all doors and windows shut during a raid.

The more successfully the whole building is kept free of gas, the less risk will there be of gas penetrating into the gas-protected room.

13. Air Locks.

An air lock is necessary at the entrance of any gas protected room or building if any number of people may have to go in or out while gas is present outside. If reliance is placed on a single door or curtain, every time it is opened some gas will enter.

An air lock consists of two gas-proof doors or curtains separated by a gas-proof compartment. If both these doors or curtains are never open at the same time, there will never be a through draught to carry gas from outside into the gas-protected interior of the building.

When curtains alone are used at the ends of an air lock, they should rest on a framework inclined some 20 degrees from the vertical, so that the curtain will lie close on the frame. Laths should also be nailed to the curtain at about one foot intervals, to keep the curtain stretched across the opening. If laths are put on both sides (as is desirable), those on the under side should be short enough to lie between the sides of the frame, and those on the upper side should be long enough to rest across the frame. When not in use, the curtain can be rolled upwards and tied to the top of the frame. The curtain can be made of oilskin, or blanket, or canvas, or any other close-woven material. If not itself gas-proof, it should be kept wet, preferably with a solution of chloride of lime, though this is not essential.

An air lock is used in the following way. Any one wishing to get into or out of the protected part of the building opens the door or curtain to get into the air lock, and then shuts that door or curtain before opening the one at the other end of the air lock. The procedure is illustrated in Fig. 2. Each door or curtain should always be opened gently, and no wider than is necessary.

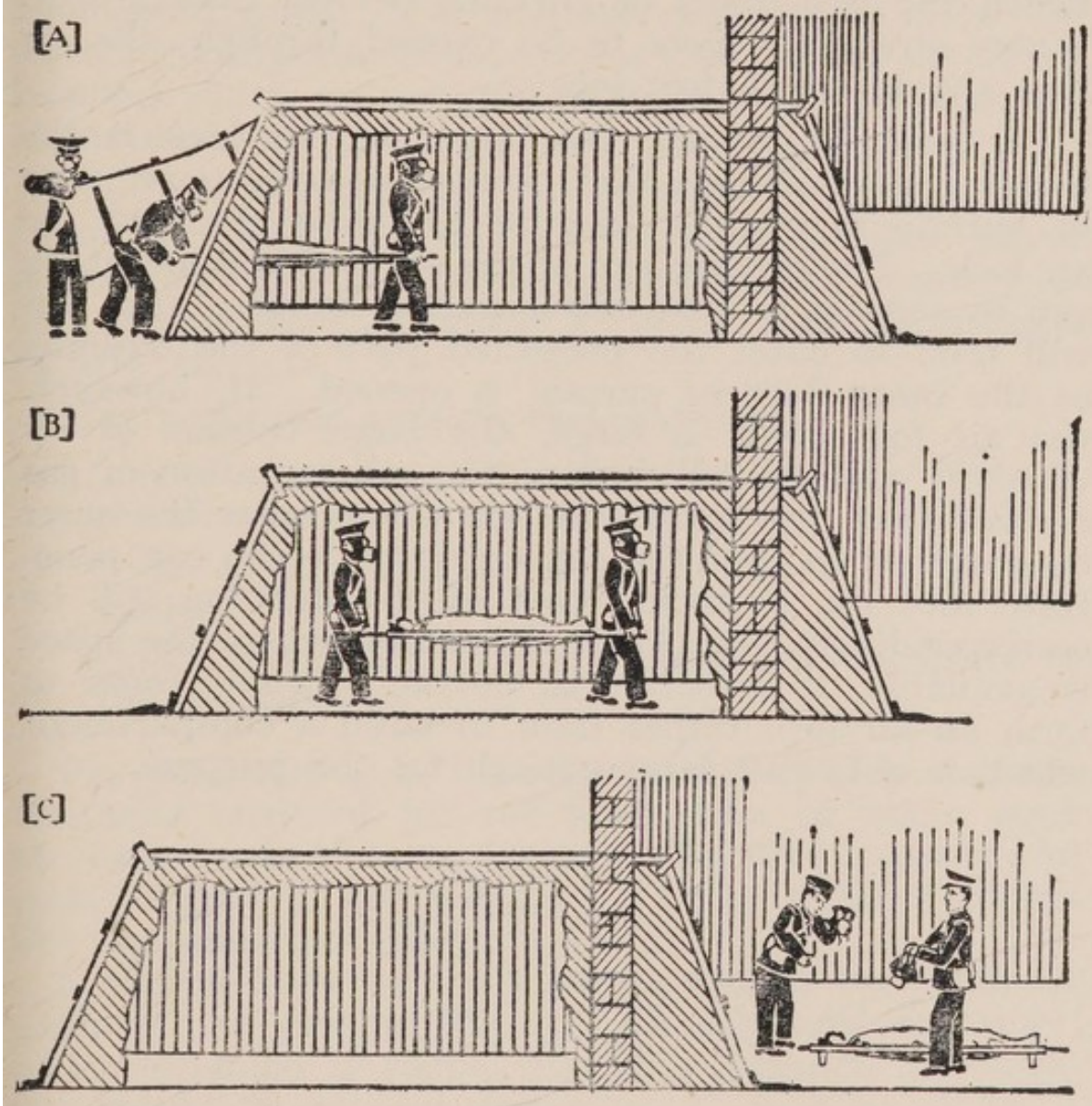

FIG. 2—AIR LOCK.

A.—ENTERING AIR LOCK.

B.—IN AIR LOCK.

C.—THROUGH AIR LOCK AND IN PROTECTED BUILDING.

The air lock must be large enough to hold all the people who need to pass through it at one time, and should have a margin of size to guard against the risk of the further door or curtain being pushed open before the first is closed. Thus the entrance to a building accommodating many people, or to a public shelter, will need a larger air lock than the entrance to a private house. In no case should the space between the two doors or curtains be less than 4 feet. Where stretchers have to be carried through, the air lock should be 10 feet long.

On general grounds, the larger an air lock is the better. It is obvious that, every time the outer door or curtain is opened, a little gas may get into the air lock. The atmosphere in the air lock will gradually get to contain a low concentration of gas, and this will tend to enter the protected part of the building as the inner door or curtain is opened. If, however, the air lock itself is large, the large volume of air which it contains will reduce the concentration of gas derived from the small amounts which enter the outer door or curtain, and the concentration which can penetrate into the protected part of the building will be correspondingly kept low. Therefore, where the space is available, it is better to devote a whole room to form an air lock rather than to build a compartment which is only just large enough for the purpose.

CHAPTER V.

PROTECTION OF THE EYES AND LUNGS.

14. The Service Respirator.

The Service respirator* is the pattern of respirator issued to the Navy, Army, and Air Force. It affords complete protection for the eyes and lungs against all known war gases,† and has been designed to allow the wearer the freedom of movement and general use of his faculties which are essential to the efficient performance of his duties.

The Service respirator will be provided for members of certain civil air raid precautions services whose duties might involve their remaining and working in high concentrations of gas (e.g., police, decontamination squads, etc.).

This respirator consists essentially of:—

(i) A container filled with material to filter or absorb the gas.

(ii) A facepiece to cover the eyes, nose and mouth.

(iii) A flexible tube to connect the facepiece to the container.

The container is a tinned iron box which contains activated charcoal for the absorption of gases, such as phosgene and mustard gas, and a filter consisting of pads to prevent the passage of finely divided smokes like the arsenical gases.

A sketch showing the construction of the Training container is given in Fig. 3. An improved container, which is similar in shape, size and resistance to breathing, would be used in war.

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* Sometimes known as the General Service respirator.

† Containers designed for protection against war gases do not give protection against carbon monoxide or carbon dioxide, which are present, for instance, in coal gas, in exhaust gases from internal combustion engines, and in "after damp" in mines.

The container can be changed without difficulty if its power of absorbing gas has become exhausted, or for any other reason it is defective.

The facepiece is made of rubber sheet (sometimes covered on the outside with khaki stockinet) which is shaped to fit closely to the face. The gas-tightness of the respirator is dependent upon the closeness of this fit and, to assist this, elastic bands are attached to the rubber and pass round the back of the head.

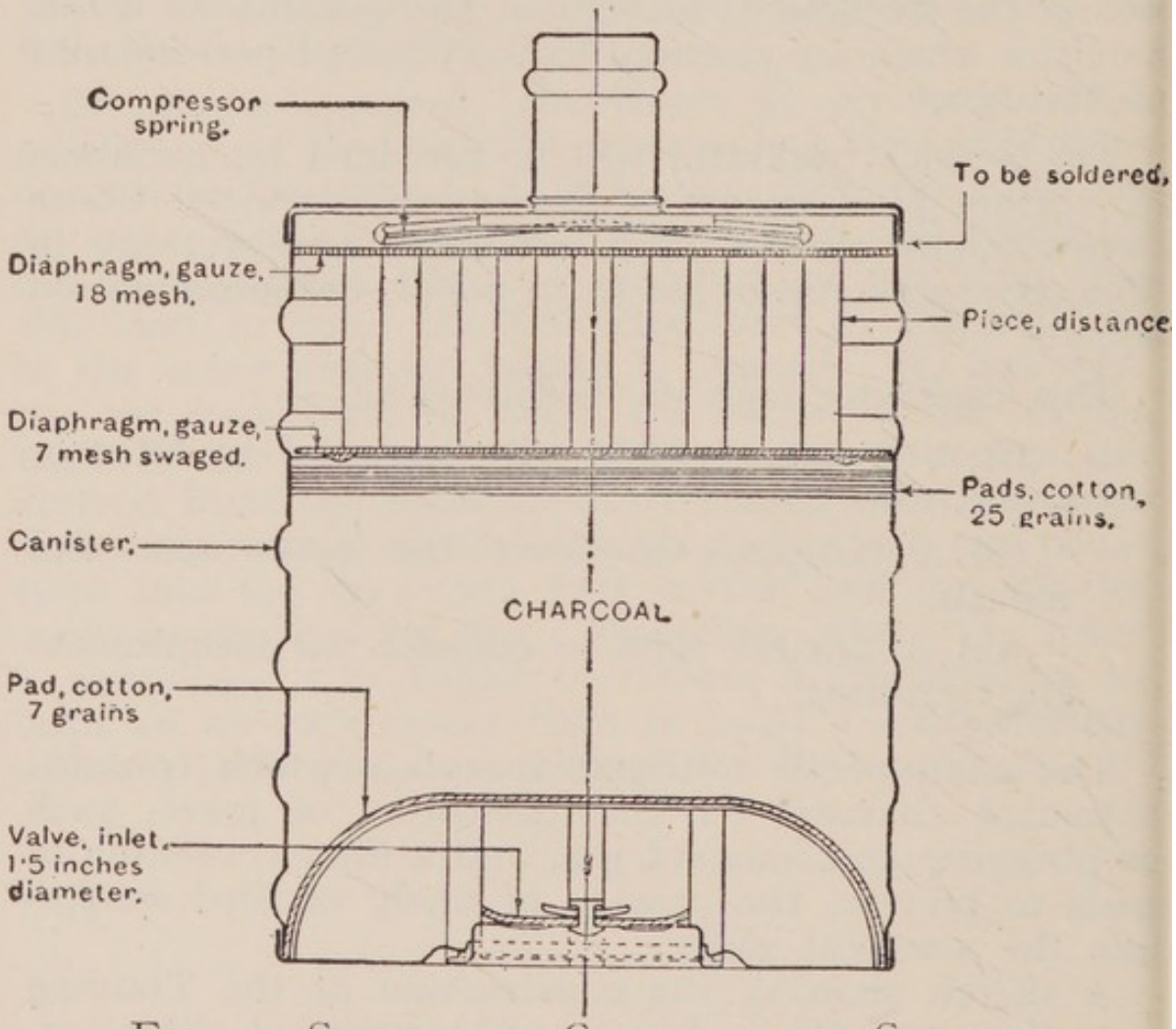

FIG. 3—SECTION OF CONTAINER OF SERVICE RESPIRATOR (TRAINING TYPE A).

These elastics are provided with buckles so that the lengths can be adjusted to suit each individual. As the facepiece is made in three sizes, no difficulty will normally be experienced in obtaining a satisfactory fit for an adult person.

The construction of the facepiece is illustrated in Fig. 4.

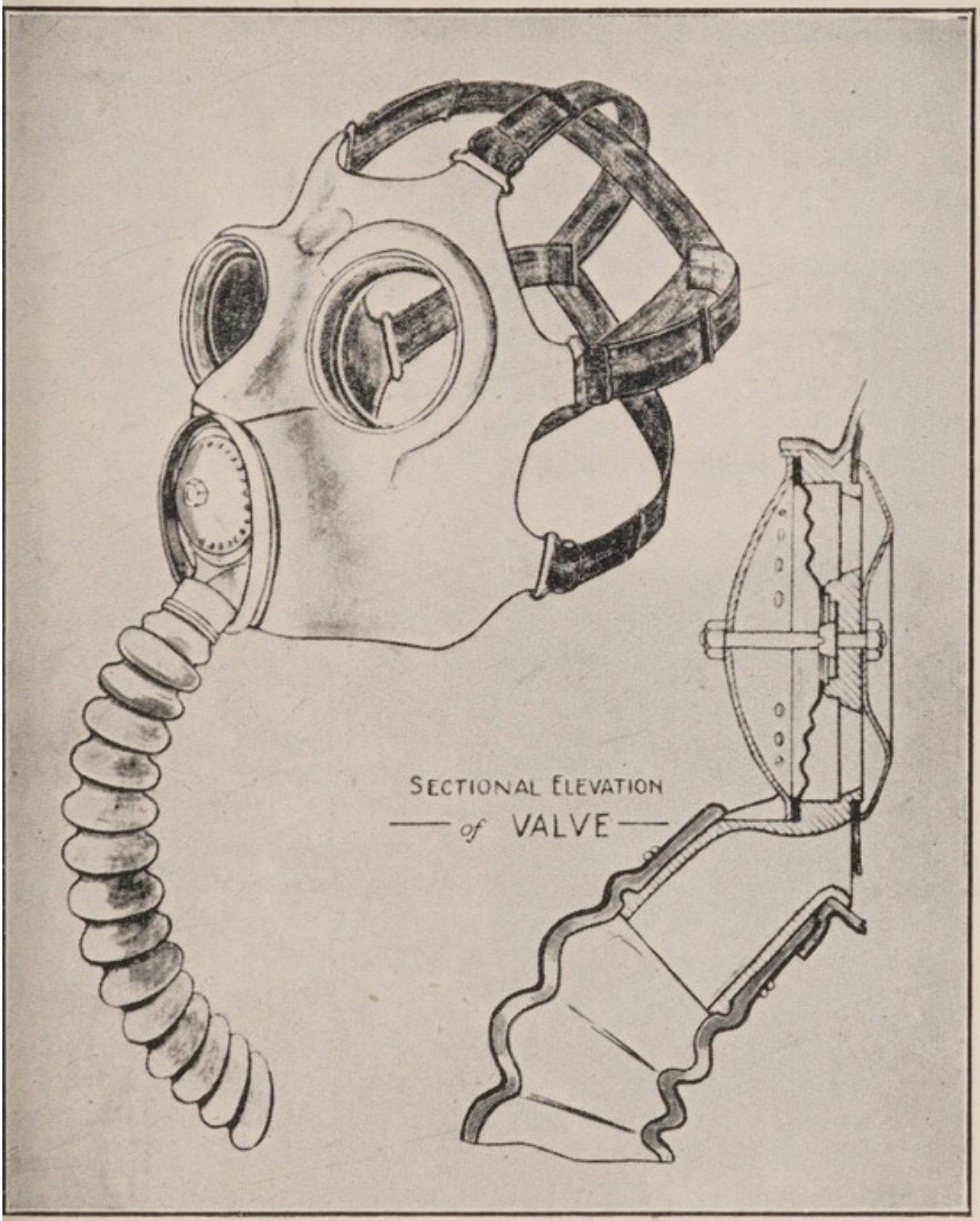

FIG. 4—FACEPIECE OF SERVICE RESPIRATOR.

The eyepieces are made of splinterless glass discs fitted into metal rims. In the more recent patterns, the glasses can be removed by unscrewing to allow decontamination of the facepiece by boiling, which would damage the splinterless glass.

A valve holder connects the facepiece to the flexible tube and contains the outlet valve. Air is drawn in from the container through the valve holder and along passages in the rubber wall of the facepiece to an inlet between the eyepieces. As a result of this arrangement, the air entering the facepiece passes across the eyepieces and so reduces the dimming caused by condensation from the expired air.

The air breathed out passes directly through the outlet valve to the outer atmosphere. This valve has been designed to render the speech of the wearer audible.

The flexible tube is made of rubber covered with stockinet; it is corrugated to give flexibility and to prevent its collapsing when bent. The ends are wired on to the valve holder at one end, and to the neck of the container at the other.

An anti-dimming outfit is provided which consists of a cylindrical metal box containing anti-dimming compound and a piece of cloth. When properly applied this compound causes the moisture condensed on the eyepieces to form a clear film which does not interfere with the vision. The instructions for using this are printed on the box and are as follows:—

> "Clean eyepiece with cloth provided. Breathe on eyepiece and apply a little compound evenly with the finger. Breathe on eyepiece again and polish *very* lightly with the cloth so that a thin even film of the compound remains."

The respirator is carried in a waterproof canvas haversack fitted with two compartments, one for the container and the other for the facepiece and anti-dimming outfit (*see* Fig. 5).

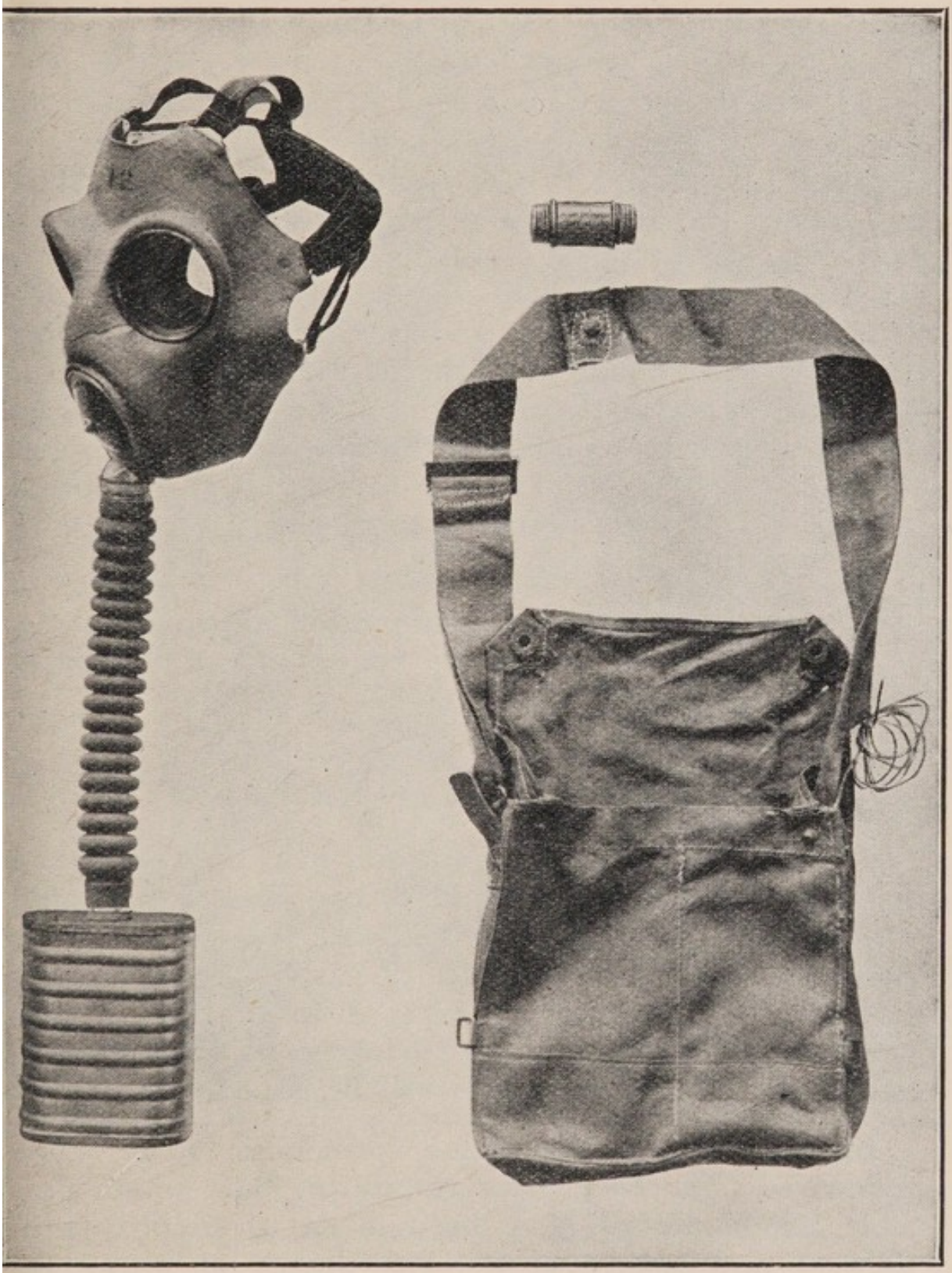

FIG. 5—SERVICE RESPIRATOR AND HAVERSACK.

The haversack may be carried in either the " slung " or " alert " position. When in the " slung " position the haversack is on the left side of the body with the sling over the right shoulder. This is illustrated in Fig. 6A. There are two methods of attaining the " alert " position. In the standard method the sling is fastened behind the shoulders by means of the whipcord which is attached to one corner of the haversack. This method is described in detail in the drill which is given in Appendix B, and is illustrated in Fig. 6B (*see also* Figs. 7 and 8). In the alternative " alert " position the sling is shortened by engaging the tab on the sling with the S hook at the side of the haversack. The haversack then remains on the chest supported from the neck and is secured to the body by means of the whipcord.

Figs. 7 and 8 show the respirator adjusted in the " gas " position, employing the standard " alert " position for the haversack.

15. The Civilian Duty Respirator.

The Civilian Duty respirator* has been designed for members of civil air raid precautions services and others who might be called upon to carry out their normal duties in the presence of gas, but who are not likely to be continuously exposed to the higher concentrations which may be encountered by those to whom the Service respirator will be issued.

In construction the same principles have been followed as in the Service respirator, but, where possible, modifications have been made to simplify production and reduce cost. The degree of protection provided is of the same order.

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* Formerly known as the Special Service respirator.

A.—Slung Position. B.—Alert Position.

Fig. 6—Service Respirator.

FIG. 7—SERVICE RESPIRATOR ADJUSTED—FRONT VIEW.

FIG. 8—SERVICE RESPIRATOR ADJUSTED—SIDE VIEW.

This respirator consists of a rubber facepiece to which a small cylindrical container is directly attached. The container is made from a metal or waterproofed cardboard cylinder on to which light metal ends are seamed. It is filled with activated charcoal, and has a filter to prevent the passage of arsenical smokes. Two valves are provided which prevent a simple backward and forward movement of air through the container. The facepiece is made of rubber without any stockinet covering. The eyepieces are made of strong plain glass and are removable for decontamination purposes.

Particular attention must be paid to the application of anti-dimming compound. If this is done, any moisture condensed on the eyepieces is converted to an even transparent film which does not seriously interfere with the vision.

The facepiece is held in position on the face by elastic bands passing round the back of the head. These can be adjusted for fit and comfort by means of buckles.

The rubber of the facepiece fits tightly round the end of the container and is secured by means of string.

A small canvas haversack is provided in which the complete respirator and anti-dimming outfit can be carried. This haversack has a webbing sling and is worn slung over the shoulder. The complete respirator is shown in Fig. 9. In Fig. 10 A and B a member of the St. John Ambulance Brigade is shown wearing the respirator slung and adjusted.

The drill for the Civilian Duty respirator is given in Appendix C.

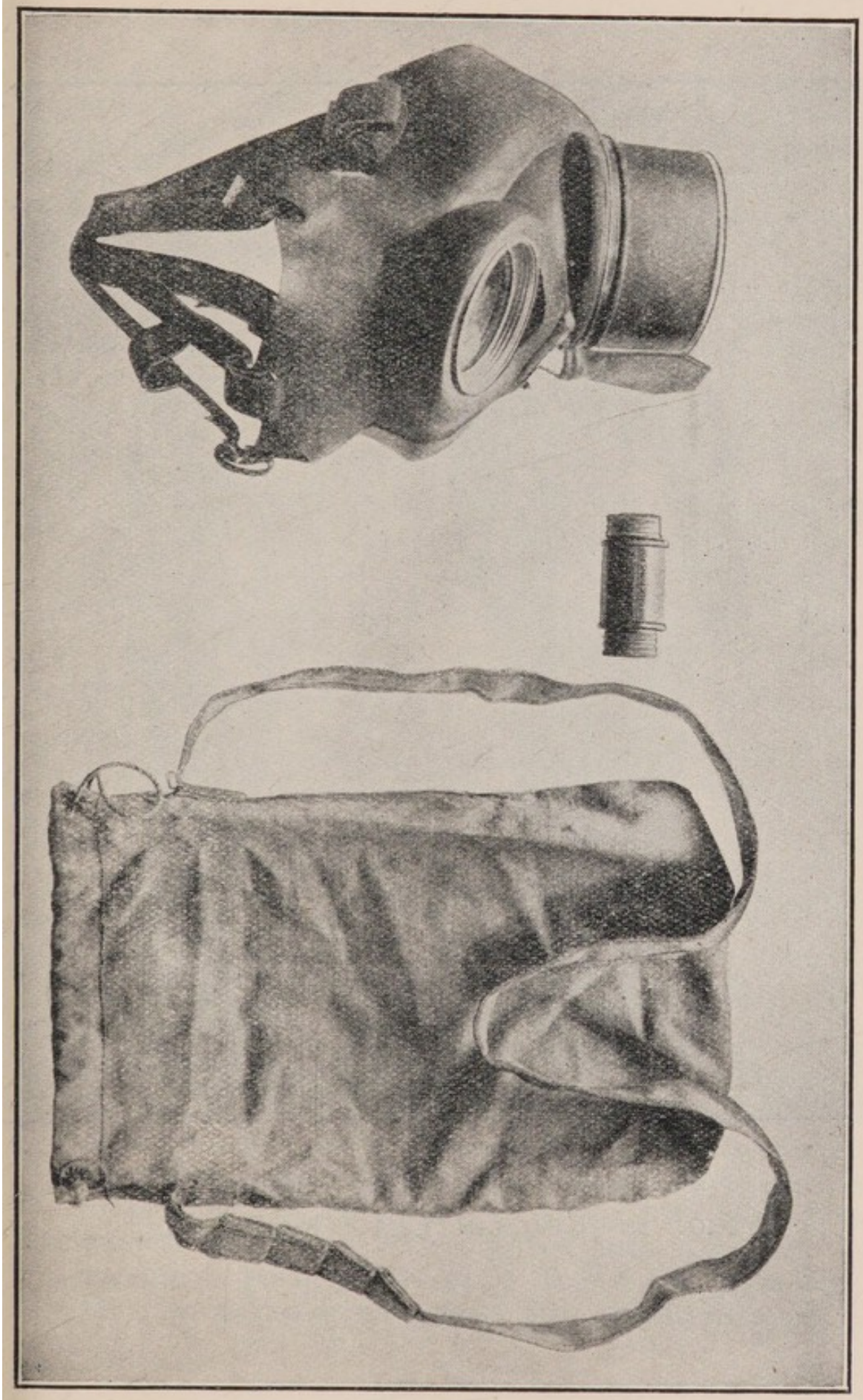

FIG. 9—CIVILIAN DUTY RESPIRATOR AND HAVERSACK.

A—Slung. B—Adjusted.

Fig. 10—Civilian Duty Respirator.

16. The Care of the Respirator.

The general principles governing the care of the respirator are the same for both patterns described above. The respirators have been designed to withstand reasonable wear and tear during use, and if properly looked after, will last at least five years. Economy of respirators is most important, and it is therefore essential that all to whom they are issued should receive thorough training in the care, wearing, cleansing and methods of folding. The more serious causes of damage are

(1) Water entering the container and affecting the efficiency of the charcoal and filter.

(2) Injury to the outlet valve which might allow gas to enter without passing through the container.

(3) Injury to the rubber facepiece or the elastic head harness.

(4) Prolonged storage *in the haversack* without use.

Attention to the following points will result in a much longer life for the respirator:—

(*a*) Respirators must be protected from wet, and when not in use should be kept if possible in a cool, dry, dark place.

(*b*) Prolonged storage of the respirator in the haversack tends to cause distortion of the facepiece and cracking of the rubber where it is folded. This can be prevented to a great extent by frequent wearing of the respirator. Where this is not feasible, as in storage, the facepieces should be taken out of the haversack at least once a month, and opened out to allow the rubber to recover its shape. (N.B.—This does not apply to facepieces packed separately from their containers, etc., for purposes of storage over a long period.)

(*c*) After use the harness and the inside of the facepiece should always be wiped dry before being put away. If wet from exposure to rain, the facepiece should not be put into the haversack until it is dry.

(*d*) In order to maintain the facepiece in a wholesome condition when in use, it should be periodically cleansed by sponging the whole of the inside with a solution of one part of Izal in 200 parts of water (two egg-cupsful to a three gallon bucket), and subsequently wiping out with water. During this process care must be taken to prevent water entering the container. The respirator should then be allowed to dry before it is put away, and in the case of the Civilian Duty respirator the gauze pad in front of the container should be renewed.

In addition the respirator should be disinfected twice a year, and on every occasion when the respirator changes ownership or if the owner contracts an infectious disease. The instructions for disinfection are issued separately.

(*e*) When a respirator is issued to an individual, great care should be taken that he is properly fitted by a competent person. The correct size of facepiece must be selected, and the head harness adjusted, to suit the requirements of the particular individual. Wherever possible the correctness of the fit should be tested by putting the person into a tear gas cloud with the respirator adjusted.

17. Inspection of the Respirator.

Respirators should be inspected frequently by a responsible person to ensure that they are in a satisfactory condition and are receiving the care and attention which they require. The inspector should pay special attention to the following points:—

SERVICE RESPIRATOR AND CIVILIAN DUTY RESPIRATOR.

(1) The elastic bands should be sound and sufficiently strong for their purposes, and buckles and loops should be firmly attached.

(2) The rubber facepiece must not be perished or torn. The presence of small holes may be detected by holding the facepiece up to the light and stretching the rubber gently.

(3) The eyepieces must not be damaged, and if of the screwed-in type they must be screwed tight. In all types the rims must be securely bound to the facepiece.

SERVICE RESPIRATOR.

(4) The valve holder must not be damaged and must be securely fixed in the facepiece.

(5) The valve guard must not be damaged.

(6) The corrugated tube must be sound and securely attached at both ends. If the container is attached at the wrong angle, the rubber tube may twist or become kinked, and the facepiece will not stay on the face properly. Hold the facepiece up by the valve holder, letting the container hang freely, in order to see that the container is in the correct position relative to the facepiece. When the facepiece is adjusted the container should hang with its widest side flat against the body.

(7) The container should show no signs of perforations, heavy denting or entry of water.

The container neck should be securely attached to the body.

CIVILIAN DUTY RESPIRATOR.

(8) The outlet valve must be securely attached to the metal mounting, and must not be perished

or punctured. By gently pulling the valve sideways and extending it about half an inch, any weakness will readily be seen.

(9) The container must be securely attached and must not be punctured or show signs of entry of water. The inlet valve must not be perished and must seat properly. The lever lid carrying the valve may be removed for inspection of the valve. If the latter is stiff it should be changed. If it is curled up but still soft it can be removed from the pin, turned over and replaced.

After the visual examination the valves should be tested in the following manner:—

Inlet valve.—Adjust the respirator to the face and close the outlet valve by pinching it or by covering the aperture, according to the type under test. Next attempt to breathe out. If air escapes, it is an indication that the inlet valve is defective, or that there is a leak in the connecting tube or container. Air may of course escape round the sides of the facepiece, but a defective inlet valve can easily be detected before the lifting of the facepiece occurs.

Outlet valve.—Adjust the facepiece as before. On pinching the connecting tube of the Service respirator it will not be possible to inhale if the valve is sound. In the Civilian Duty respirator, the normal entrance of air may be stopped by holding the palm of the hand firmly over the valve at the bottom of the container. If the outlet valve of the Civilian Duty respirator is stuck owing to saliva drying upon it, this can be remedied by rubbing the valve gently between the thumb and fingers.

Before replacing the Service respirator in the haversack, the latter should be examined to see that the

boiling, brass stud, leather tab, press buttons, cord and D's are all sound. The presence of the anti-dim outfit should also be checked.

After Service respirators have been inspected, they should be adjusted to the face at the conclusion to make sure that the containers have been correctly replaced in the haversacks, so that the rubber tube is not kinked.

CHAPTER VI.

PROTECTION OF THE BODY.

18. Need for Protection of the Skin against Blister Gases.

It has already been stated that the most dangerous gas likely to be met is mustard gas, or something of a similar type. For those who have to encounter such a gas for an appreciable time, the protection given by the respirator alone is not sufficient.

The respirator container will prevent mustard gas vapour from passing through it. Thus a person wearing his respirator will have his face and respiratory system protected, but the remainder of his body will be liable to injury by the liquid or vapour. Ordinary clothing is of some value in that it delays penetration by vapour, and to a less extent liquid, and therefore the full effects of any contamination are not immediately produced on the skin. If such clothing is removed *quickly* and the skin thoroughly washed, damage may be entirely avoided, or at any rate very much reduced. The treatment is described in Chapter VII.

On the other hand, should it not be known that contamination has occurred, the clothing will be a source of grave danger, since it will maintain the gas in close proximity with the skin. By the time irritation is noticed, the mustard gas will have penetrated well into the skin and the damage will have been done.

19. Protective Clothing.

Whenever it is necessary for particular individuals to carry out essential work in places where they are likely to be exposed to either liquid mustard gas or high concentrations of the vapour, they must be protected by some form of clothing which the gas cannot penetrate. The best material for resisting the penetration of liquid mustard gas is oilskin of the type used in the Navy. This

oilskin is manufactured from various textile materials by treating them with certain "drying" oils such as linseed oil.

It should be noted that the time taken by the liquid mustard gas to get through this oilskin material in hot weather is about half the time taken in cold weather. This must be taken into account when deciding the safe limit of time for which articles of protective clothing may be worn. Naturally the time of penetration will vary for different grades of material, but the strong oiled wigan of which protective gloves are made will, when new, keep out liquid mustard gas for at least four hours even in hot weather. Garments of this material are decontaminated by boiling, which treatment reduces the penetration time. After being boiled, clothing should not be reckoned as capable of keeping out liquid mustard gas for more than three hours.

The non-porous nature of this oilskin material causes the heat and perspiration from the body to be retained inside the clothing. In hot weather the amount of manual work that a person wearing oilskins can accomplish is consequently limited, owing to fatigue and exhaustion.

A complete protective suit of oilskin consists of the following garments:—

Oilskin jacket,
Oilskin trousers,
Oilskin hood,
Oilskin gloves,
Rubber gum boots (to the knee).

Only underclothing should be worn under this suit. The rubber boots are necessary because leather gives only a short period of protection against mustard gas, and is difficult to decontaminate.

A man equipped in the full protective suit, but without the hood, is shown in Fig. 11.

FIG. 11—MAN EQUIPPED WITH FULL PROTECTIVE CLOTHING, WITHOUT HOOD.

The wearing of this complete suit quickly gives rise to exhaustion, and the following modified suit is provided in place of it for those less likely to be working in heavy concentrations of gas, e.g., undressers of contaminated patients in first aid posts:—

Oilskin coat, or apron with sleeves.
Oilskin gloves,
Rubber gum boots (to the knee).

Underclothing and a strong cotton suit or overall should be worn under this modified suit.

20. Use of Protective Garments.

Complete protective suits will have to be issued to those persons whose duties require them to work in areas where they are liable to come into contact with quantities of liquid mustard gas or where there are high concentrations of vapour which would readily pass through ordinary clothes.

Owing to the exhaustion which they cause, these complete suits should not be worn unless the circumstances make it essential. Where adequate ventilation can be arranged to avoid dangerous concentrations of vapour, so that the only danger is from touching contaminated objects, the modified suit (coat or apron, etc.) may afford adequate protection and cause much less reduction in efficiency. This modified suit should, for instance, be adequate for first aid personnel who are merely handling casualties who may be contaminated, and rubber boots might not be needed.

Wherever there is any danger from vapour the respirator must be worn, and if there is mustard gas on the ground, rubber boots are required.

The necessity for other articles of protective clothing will depend on the particular circumstances and nature of the work to be undertaken.

Protective gloves can be made of various qualities of oiled fabric according to the work for which they are intended. The gloves which are most suitable for general work have a separate thumb but all the fingers in one piece. These are cheap and easy to manufacture.

When a respirator is worn in conjunction with an oilskin jacket, considerable portions of the head and neck remain exposed. To protect these parts, an

oiled fabric hood has been designed which has to be adjusted after the respirator is in position on the face, the lower part of the hood being tucked inside the collar of the jacket.

Before putting on the complete protective suit, it will be necessary to remove the ordinary clothing and change into other underclothing. In temperate climates a fit man so equipped can normally do two spells of work of two hours each during the day, if an interval of four hours' rest is allowed between the spells of work. On a hot day the spells of work would have to be shorter, but in cold or wet weather the working time can be extended. The wearing of the hood adds considerably to the distress of the person and should only be insisted on when the work has to be performed in a confined space which contains mustard gas vapour.

Under circumstances which do not render the wearing of the hood essential, the remainder of the protective clothing may be worn for two spells of work of about four hours each.

The protection against mustard gas vapour afforded by the full protective suit is of limited duration, owing to the suction effect produced by movement. The inside of such suits should therefore be ventilated at regular intervals by opening the coat and letting down the trousers in an atmosphere free from mustard gas vapour.

21. Order of Dressing and Undressing.

The order of dressing in full protective clothing should be as follows. Where possible another man should assist as a dresser.

(1) Attend to wants of nature.

(2) Remove own clothing, underclothing and socks.

(3) Put on clean underclothing and socks.

(4) Put on trousers.

(5) Put on boots, with trousers draped " plus fours " fashion over top.

(6) Put on jacket.

(7) Adjust respirator in Alert position.

(8) Put on gloves, which are tied at wrist by dresser.

(9) Put on sou'wester or helmet.

The hood should not be put on until after the respirator is adjusted in the Gas position, when gas is encountered.

After each period of work the protective clothing should be removed by another man (himself suitably protected) and the wearer must wash thoroughly and change back into his own underclothing.

The various articles of clothing should be taken off in the following order:—

(1) Hood, or sou' wester, or helmet.
(2) Gloves.
(3) Respirator.
(4) Jacket, coat or apron.
(5) Trousers lowered.
(6) Boots removed.
(7) Trousers removed.
(8) Underclothing.

These articles should each be placed in the appropriate covered bin as removed.

The man who is being undressed should then move his feet to the other side of the form on which he is sitting without letting them touch the floor, and take off his underclothing which he should put into an appropriate bin.

This move is necessary because the floor on which the boots and oilskin clothing are removed may have become contaminated as a result of successive persons undressing on it, and to stand on it with bare feet would be dangerous.

The bins for the contaminated clothing can be ordinary sanitary bins with lids, and separate bins will be required for the following:—

(1) Boots.
(2) Protective clothing.
(3) Respirators.
(4) Underclothing.

CHAPTER VII.

ANTI-GAS TREATMENT OF PERSONS AND DECONTAMINATION OF CLOTHING AND EQUIPMENT.

22. Anti-Gas Treatment of Persons

Mustard gas, or any other blister gas, has a serious effect on the skin of any person who comes in contact with it.

The contamination to which these gases give rise is really the same on persons as on things, and any process for removing it, whether by washing with water or the application of neutralising chemicals, may be rightly described as " decontamination " in either case. The premises and the personnel for dealing with persons must, however, in civil air raid precautions, be distinct from those connected with the removal of contamination from streets, buildings, and material objects generally, with the result that confusion is apt to arise if the word " decontamination " is used indiscriminately in relation to both aspects. It is therefore proposed that the words " decontaminate " and " decontamination " should be reserved for the removal of contamination from material objects, and that the removal of bodily contamination of persons should be described as anti-gas treatment, or by the use of such neutral words as cleansing or washing. The facilities which must be specially provided for these purposes (except as regards the members of air raid precautions services, as described in the next Section) are to form part of the first aid organisation, and neither the places nor the personnel employed need be designated otherwise than as first aid posts and first aid personnel.

Any person who has become contaminated by blister gas through exposure to vapour or through contact with liquid, must be speedily treated to prevent his becoming a casualty. Even if the treatment is unavoidably delayed, it will in many cases reduce

the severity of the injuries. But it cannot be over-emphasised that *speed of action is of the utmost importance.*

The first essential is to remove the clothing which has become contaminated and to dispose of it in such a way that it does not become a source of danger to others.

Contamination of the skin by liquid should be treated as follows:—

(i) When bleach ointment is immediately available it should be well rubbed into the contaminated area and then wiped off within two minutes.

(ii) If a paste of bleaching powder and water can be made available within five minutes the affected part of the body should be treated with this paste.

In the case of either of the above treatments the contaminated persons should be thoroughly washed with hot water and soap as quickly as possible.

(iii) If neither bleach ointment nor bleach paste can be made available within five minutes of the contamination the individual should be hurried to a First Aid Post and washed with hot water and soap immediately. The bleach mixtures are only more efficacious than washing when they can be applied within five minutes of contamination.

In cases of vapour contamination of the skin the best treatment is washing with soap and hot water as soon as possible.

In all cases it will be an added safeguard to bathe the eyes with warm water.

The preceding paragraphs deal with cases in which definite contamination of the skin is known to have occurred. Whenever contamination is suspected, or is liable to have occurred, the general procedure should still be to undress and thoroughly wash the whole body with soap and warm water at the earliest

opportunity. Fresh clothing should then be put on, and on no account must the contaminated clothing be worn again until it has been decontaminated as laid down in Section 24.

This procedure can and should be undertaken by the public in their own homes or places of work if it can be managed sufficiently promptly and if the contamination is not very severe. Where, however, there might be delay, and in cases where contamination with liquid mustard gas has occurred through the bursting of a bomb, etc., the outer clothing should be removed at once, and treatment sought at a public First Aid Post. Here it will be possible for the person to wash, to put on clean garments, and to receive such first aid treatment as his case may demand.

The danger of causing further casualties by contaminated clothing which has been discarded requires stressing. Persons who intend treating themselves in their own homes must remove their boots and outer clothing before entering the house.

An undresser wearing suitable protective clothing should be provided at each First Aid Post to assist in the removal of contaminated clothing.

23. Preventive Cleansing for Members of Air Raid Precautions Services.

As has already been made clear, the danger of mustard gas and similar blister gases is that either the liquid or the vapour can be absorbed by the skin without being detected at the time. The symptoms may not appear for several hours.

In the case of members of air raid precautions services who have been on duty in an area where mustard gas was present, it will be desirable for them to undergo cleansing treatment as soon as they come off duty, as a routine precaution, irrespective of whether any particular man believes himself to have been exposed to gas.

Special accommodation, on the lines indicated in Appendix D, should therefore be provided at the station or depot from which members of air raid precautions services would have to work. The routine should be that when the men come on duty they should take off their own clothing (including underclothing) and put on other clothing provided for the purpose, and when coming off duty should take off their duty clothing and wash themselves before putting on their own clothes once more. As has already been pointed out this change of underclothing will be necessary whenever they have to wear oilskin protective clothing, whether they encounter gas or not.

It should be noted that undressers (themselves wearing some form of protective clothing) should be available to take off the contaminated clothing of the men as they come off duty. Men who undress themselves may spread contamination from their clothes to their bodies.

The arrangements for dealing with the contaminated clothing should be as described in the following Section, unless it is decided that it is more convenient to decontaminate it on the spot.

24. Decontamination of Clothing.

The decontamination of clothing needs time, and in cases of severe contamination is an elaborate process. A special organisation, with suitably equipped premises, should therefore be provided, and this organisation should be capable of dealing with the clothing of the air raid precautions services discarded at their stations or depots, as well as the clothing of the public discarded either at home or at First Aid Posts.

Clothing which is, or is suspected of being, contaminated with liquid mustard gas should not be decontaminated at home. If removed at home it should be taken in a closed metal receptacle to a First Aid Post or to some special depot for cleansing.

The following methods of decontamination are recommended for articles of clothing of various types. Where it is *known* that garments have been exposed to vapour only, the simpler methods recommended may be used. If there is even a *possibility* of liquid contamination, the garments should be treated as if they were *known* to be contaminated by liquid.

ORDINARY CLOTHING.

Vapour contamination only.

(1) Hang in the open air, for at least 24 hours. Suitable for overcoats, hats, coats, trousers, dresses, etc. If the clothing still smells of the gas after 24 hours, treat as for liquid contamination.

(2) Wash with soap and water for at least 15 minutes. Suitable for light dresses and underclothing.

Liquid contamination.

(1) Special treatment in a steam disinfector. Suitable for overcoats, coats, trousers, dresses and any articles made of woollen cloth.

(2) Boil in plain water for at least 60 minutes. Suitable for any washable clothing and underclothing.

PROTECTIVE CLOTHING.

Vapour contamination.—This clothing, if only contaminated by vapour, may be satisfactorily decontaminated by hanging in the open air for at least two hours.

Liquid contamination.—Protective clothing contaminated by liquid mustard gas should be decontaminated by hosing off any visible liquid with water, and then boiling the clothing in water for half an hour.

BOOTS.

(1) *Rubber boots and goloshes.*—Stout rubber boots without any leather parts give good protection, but when the wearer has

trodden in heavy contaminations, it is advisable first to stand them in a tray of bleaching powder as soon as possible after they have been taken off, and to brush the uppers with the powder, to destroy any liquid mustard gas which has not already soaked into the rubber.

Rubber boots and goloshes are decontaminated by complete immersion for two hours in water which is kept boiling. After this treatment, they should be wiped inside and out, and placed in a warm room to dry.

(ii) *Leather boots.*—Leather boots are quite unsuitable for use in heavily contaminated places, or for decontamination work. When leather boots have unavoidably to be used in contaminated localities, they should first be thoroughly greased with a mixture of bleaching powder and vaseline (2 parts of bleaching powder to 1 part of vaseline) just before being worn. This mixture will help to delay the penetration of mustard gas into the leather, and should be wiped off at the end of the spell of work. A fresh application should be made before the boots are worn again. To obtain the maximum protection with leather boots, only those with sound and thick soles should be used.

The decontamination of leather boots or shoes is a difficult problem, as they cannot be boiled like rubber boots.

With due care and observance of instructions it is considered that most people should be able to avoid getting their boots contaminated.

Walking along a pavement or metalled road contaminated with mustard gas will not cause serious contamination of the boots unless splashes or pools of liquid are lying about.

Persons who have walked through contaminated areas should examine the soles and uppers of their boots to make sure that the boots are not contaminated with liquid mustard gas, taking care while doing so that they do not contaminate their hands. If any trace of mustard gas can be seen or smelt the boots must be taken as soon as possible to the First Aid Post or other appropriate place for treatment.

25. Decontamination of Respirators.

The following methods of decontaminating respirators are recommended:—

Vapour contamination.—The facepieces of Service and Civilian Duty respirators (*see* Chapter V) are made of rubber and fitted with removable glass eyepieces. If these respirators have been subjected to vapour only, it will be sufficient if, after use, both respirator and haversack are hung separately in the open air, until they are required for the next spell of work. Where possible, this airing should last for 24 hours. During this process, the respirators should, of course, be protected from rain.

Liquid contamination.—If there is any sign of liquid contamination, the respirator must be withdrawn and another issued in its place.

For the decontamination of the respirator from liquid mustard gas, it will first be necessary to dismantle it. Where possible the eyepieces should be removed and the container detached from the facepiece. The rubber portion, consisting of the facepiece, with or without a connecting tube (according to the pattern of respirator in use), should be immersed in water and kept boiling for two hours.

The eyepieces and the outside of the container should be treated with a paste of bleaching powder and vaseline for ten minutes, and then wiped clean.

The haversack, if also wetted with liquid mustard gas, will require boiling in water for half an hour. Any leather tabs attached to it will have to be renewed subsequently, since the boiling treatment renders them hard and brittle.

26. Decontamination of Stretchers.

The standard pattern of stretcher in use has wooden handles. In most cases the supporting material is canvas. Any leather fittings will add to the difficulties of decontamination and should be removed. The most important point is to avoid contamination as far as possible. To protect the stretcher from contamination it should be covered with a suitable oilskin sheet which can be readily decontaminated by immersion in boiling water as laid down for protective clothing in Section 24.

Should the stretcher become contaminated in spite of this precaution, the canvas will have to be removed from the handles and immersed in boiling water for 30 minutes. The handles will require scrubbing with the paste made from bleaching powder and water, but they will not be safe for contact with the bare hands for some days. This delay can be avoided by fitting the handles with oilskin covers.

Stretchers which have only been contaminated by vapour should be allowed to air in the open when not in use.

APPENDIX A. [§12

The Selection of Rooms for Gas Protection.

In each house a room or rooms should be prepared to prevent the entry of gas, so that it may be safely occupied during a raid in which gas is used. The room to be protected should therefore be selected on the following principles:—

(1) A cellar or basement is best, always provided that there is no risk of flooding and that alternative means of exit exist.

(2) If there is no basement, choose a room on the ground floor.

(3) The windows of the rooms should be small and if possible not in an exposed position. If they face soft ground, the blast of an exploding bomb may be more smothered than if they face a paved or metalled surface. The glass will in any case be liable to be broken by the explosion of high explosive bombs, even at a considerable distance, and some other covering will have to be fastened over the window frame.

(4) Where possible, the room should be on the side of the house least exposed to the prevailing wind. Wind pressure will assist the entry of gas through small crevices and ill-fitting window frames.

(5) The entry of gas into a house is always assisted by draughts, so it is important to shut *all* doors and windows throughout the house before withdrawing to the gas-protected room.

(6) Apply the general gas-protection instructions to the whole house so far as possible, after paying special attention to the selected room. If the penetration of gas into the house is reduced to a minimum, the occupants of the protected room will be all the safer, and a great deal of

trouble will be avoided because the house will not subsequently need airing to the same extent as if gas had penetrated freely into the interior.

The number of people who can safely remain in unventilated rooms for any prolonged period is naturally limited. If a room contains too many people, the first trouble will not be shortage of oxygen or increase of carbon dioxide, but intolerable discomfort due to rise in temperature and humidity of the air. The capacity of a room is therefore to be measured, not by its cubic content of air, but by the surface area available for the removal of heat and the condensation of moisture.

Under English summer conditions, closed rooms may safely be occupied for periods up to 12 hours if the surface area of the walls, floor and ceiling is equivalent to an allowance of 100 sq. ft. per person. The following are examples of how this formula works out in typical rooms.

Size of Room.	*Permissible Occupants.*
10 × 10 ft. × 8 ft.	5
15 × 10 ft. × 8 ft.	7
20 × 15 ft. × 10 ft.	13
30 × 15 ft. × 12 ft.	20

Note that these calculations are NOT based on cubic capacity, which would give different figures.

APPENDIX B. [§14

The Fitting and Use of the Service Respirator.

A.—Fitting.

The facepiece of the Service respirator is made in three sizes: the NORMAL size which fits most men's faces and some women's faces; the LARGE size which may be required for some men; and the SMALL size which in general is most suitable for women and adolescents. The difference between them lies only in the dimensions of the rubber facepiece. The size is marked on the inside of the facepiece over the nose, and also outside on the stockinet under the chin.

The elastic headharness serves to hold the respirator against the face, and, to suit different heads, each elastic band can be adjusted in length by means of buckles.

The operation of fitting a respirator consists in—

(*a*) selecting the correct size for the wearer's face,

(*b*) adjusting the elastic bands of the headharness, so that when it is worn, the respirator is gastight, comfortable, and stable on the face.

This cannot conveniently be done by the wearer himself; it should be carried out by a second person in the following manner:—

Operation 1.—*Preliminary.*

First slacken off all the elastic bands of the headharness, so that the ends are about one inch from the buckles, and then instruct the wearer to put on the respirator. If spectacles are worn they should first be removed. Then, while the respirator is in position on the face, tighten each of the elastic bands so that

the facepiece is drawn into firm, but not uncomfortable, contact with the skin and, as near as can be judged, all the bands are exerting an equal pull. Make certain that the wearer's chin is fitting closely into the chin of the facepiece.

Operation 2.—Observe if the size is correct.

The size of the respirator is generally correct if the wearer's eyes appear roughly midway between the top and the bottom of the eyepieces. If the eyes are much *below* the centre of the eyepieces in a NORMAL size it must be exchanged for a SMALL size. If the eyes are much *above* the centre in a NORMAL size then a LARGE size is required.

Operation 3.—Adjust the headharness.

The facepiece of the respirator is made of soft and flexible rubber so that it will naturally tend to shape itself to the face and make close contact with the skin without using strong pressure. It is not necessary therefore, to wear the headharness very tight in order to obtain a gastight fit; in fact, if the elastic bands are drawn too tight they may actually cause leakage by stretching the rubber and so prevent it from taking the shape of the face. The headharness should be no tighter than is needed to hold the facepiece firmly on the face during the carrying out of all duties, without causing discomfort.

(i) Instruct the wearer to move the head fairly vigorously in all directions and note if the facepiece slips on the skin. If it does so, all the elastic bands should be gradually tightened until the respirator is firm.

(ii) Next instruct the wearer to bend the head slightly forward and nod several times. The facepiece should neither slip down on the face nor the point of the chin jump out of the chin pocket. If either of these movements occurs, the two top elastic bands which pass over the crown of the head should be tightened.

(iii) Now grasp the facepiece with one hand round the valve holder and attempt to pull it gently away from the face. If the facepiece is felt to leave the chin easily, the two bottom elastic bands which pass under the ears should be tightened until the wearer can feel no movement away from his chin when the facepiece is thus pulled.

(iv) Ask the wearer to confirm that the respirator is comfortable and is not pressing unduly at any point.

Operation 4.—Test for gastightness.

Now that the respirator has been comfortably fitted it must be tested to make sure that no air can leak in between the facepiece and the face. Grip the connecting tube near its lower end and squeeze it tightly so that no air can be drawn through it. Instruct the wearer to attempt to breathe in and to say if air is felt to leak in at any point around the facepiece. If any such leakage is reported it can often be confirmed by placing the ear close to the facepiece and listening for the hiss of the inrushing air. The exact position of the leak can be located by pressing the tips of the fingers lightly on the outside of the facepiece at the suspected point and noting when the leakage ceases. If leakage does occur at any point, the adjacent elastic band or bands must be readjusted until the leakage ceases, remembering that the leakage *may* be due to excessive tightness of the elastic and that a slight slackening off may allow the rubber to make better contact with the skin.

If the wearer normally uses spectacles, they may be worn under the respirator *provided that* it is ascertained with certainty that they do not cause leakage at the temples. Most spectacles now in use are not suitable for wearing with a respirator because of this leakage, but on the majority of faces the type having thin wire frames may safely be worn Thick

horn spectacles are not likely to be safe. When the respirator has been fitted as described above, instruct the wearer to put on the respirator over his spectacles. Then repeat the test for gastightness. If there is no leakage, or if there is only a minute leakage when the breath is drawn in so strongly *that the facepiece is sucked in against the face,* the wearer may use his spectacles with the respirator. A slight tightening or loosening of the elastic bands which are attached at the temples may be found to improve the fitting over spectacles, but no greater leakage than that described is permissible. The anti-dimming compound provided with the respirator must be used on *both* sides of the glass of the spectacles.

B.—The Use of the Service Respirator.

It is assumed that the respirator has already been fitted to the wearer—that is, that the headharness is correctly adjusted to fit his head.

1. *General.*—The respirator is carried in the haversack, the container being in the smaller (right hand) compartment and the facepiece in the larger compartment together with the anti-dimming outfit. The container must be inserted so that when the facepiece is worn the connecting tube is not twisted or kinked.

2. *When it is known that there is no gas in the vicinity, or when there is no likelihood of gas being encountered,* the respirator is carried in the SLUNG position as follows:—

Respirator in haversack.

Haversack press buttons closed.

Haversack at left side of the body (press buttons next to body) and sling over the right shoulder, the length of sling being adjusted by the brass slide to suit the wearer's comfort. Haversack to be on top of any other equipment being worn.

3. *When the presence of gas in the vicinity is suspected, or when there is likelihood of gas being encountered* (e.g., during an air raid) the respirator is to be brought to the ALERT position as follows:—

(i) Swing haversack to front of body and bring left arm through sling so that haversack hangs straight down from the neck.

(ii) Undo press buttons with sharp pull.

(iii) Raise haversack on to chest, allowing sling to fall down the back.

(iv) Withdraw whipcord from haversack, pass through "D" ring on right side of haversack, through the sling behind the back and fasten to "D" ring on left side of haversack with a slip knot.

(v) Fold haversack flap over between haversack and body.

4. *Immediately gas is encountered, or the alarm "GAS" is received,* the respirator is to be put on as quickly as possible. Rapid protection can be obtained only by following the correct details of respirator drill, which are as follows:—

(i) Hold the breath.

(ii) Remove headgear and place between the knees.

(iii) Lift the flap of the haversack. With the right hand seize the facepiece by the valveholder, pull it out of the haversack and turn it towards the face ready for putting on.

(iv) Insert the left thumb under the centre of the headpad by passing it under the point where the two bottom elastic bands are attached, and allow the facepiece to hang by the headharness. Insert the right thumb beside the left thumb and then slide the thumbs wide apart along the two adjacent elastic bands on each side.

(v) Thrust the chin forward into the chin of the facepiece and draw the facepiece on to the face by passing the harness smartly over the head with the thumbs.

(vi) Breathe out and continue to breathe in a normal manner.

(vii) Adjust the facepiece squarely and comfortably on the face and run the fingers over it to make sure that the edges are not doubled inwards nor the elastic bands twisted.

The canvas pad of the harness should be centrally positioned at the back of the head.

(viii) Replace headgear.

In the case of men wearing caps, helmets, or sou' westers with chinstraps down, the head-dress should be removed and hung on the left forearm until the adjustment of the facepiece is complete, when it should be replaced, with the chinstrap at the back of the head.

5. If gas is encountered or the alarm "GAS" is received *when the respirator is being carried in the "SLUNG" position,* protection can be obtained as follows:—

(i) Hold the breath.

(ii) Swing the haversack to the front of the body and slip the left arm through the sling. Undo the press buttons with a sharp pull.

(iii) Bend forward and withdraw the facepiece and adjust it as detailed above in 4 (ii) to (viii).

(iv) When protection has been obtained bring the haversack to the ALERT position in the usual way.

In the case of men wearing caps, helmets or sou' westers with chinstraps down, the head-dress should be removed and hung on the left forearm after the left arm has been slipped through the sling, and replaced with the chinstrap at the back of the head when the adjustment of the facepiece is complete.

6. *When it is thought that gas may no longer be present,* the air must be tested for gas before the respirator is taken off. First take a fairly deep breath, then insert two fingers of the right hand between the cheek and the facepiece and lift it slightly away from the face. Sniff gently. If gas is detected, or *if there is any doubt,* replace the facepiece at once and breathe out strongly to blow out any gas which might have leaked in during the test.

7. *When the air is known to be clear of gas,* the respirator may be removed. Raise the headgear with the left hand, insert two fingers of the right hand under the chin of the facepiece and lift the respirator off with an upward and backward movement over the head. Replace headgear (with the chinstrap under the chin in the case of men wearing caps, helmets or sou'-westers with the chinstrap down).

8. *After using the respirator,* the inside of the facepiece should be wiped dry with a clean cloth before it is put away. If possible, the eyepieces should also be treated with anti-dimming compound so that the respirator is ready for the next emergency, but if conditions do not permit of an immediate treatment *the first available opportunity of doing so must be taken.*

To Replace the Facepiece in the Haversack.

Hold the respirator in the right hand, thumb on one eyepiece, fingers on the other, with the valve-holder in the palm of the hand.

Fold in the forehead portion so that it separates the eyepieces.

Squeeze the eyepieces together and replace the respirator in the haversack, forehead portion first, harness buckles to the wearer's right.

To Adjust a Service Respirator on another Person.

The following instructions are given for adjusting a respirator on another person who cannot do it for himself (if, for instance, he is already injured). The

procedure can be carried out on anyone who is sitting or lying. It cannot normally be used on anyone who is standing erect.

The key to the fitting is the chin. Unless the chin is lodged in the chin-hollow of the facepiece it is impossible to ensure that the facepiece is adjusted correctly.

(i) After adjusting your own respirator, bring the other man's haversack to the front of the chest, sling in the usual Alert position, but do not waste time, at this stage, in tying the whipcord. Take the facepiece out of the haversack and hold it with the outlet valve towards you.

(ii) Slip both hands into the facepiece from above, palms facing, finger tips almost in the hollow for the chin, thumbs extended and supporting the harness. The edges of the facepiece can be conveniently steadied between the forefinger and middle finger. The backs of the hands and fingers are thus against the rubber of the facepiece and the side straps of the harness.

(iii) Get the man's chin into the chin hollow, and as soon as it is in position slip the hands out, up either side of his face, catching the harness on the way, and slipping it over the head.

(iv) Adjust the harness tension and the edges of the facepiece.

APPENDIX C. [§15

The Fitting and Use of the Civilian Duty Respirator.

A. Fitting.

The respirator is made in two sizes: the NORMAL size, which fits most men's and some women's faces; and the SMALL size which, in general, is most suitable for women and adolescents. The difference between them lies only in the dimensions of the rubber facepieces. The size is marked on the outside of the facepieces on the right cheek.

The elastic headharness serves to hold the respirator against the face, and, to suit different heads, each elastic band can be adjusted in length by means of buckles.

The operation of fitting a respirator consists in—

(*a*) Selecting the correct size for the wearer's face, and

(*b*) Adjusting the elastic bands of the headharness, so that when it is worn, the respirator is gastight, comfortable, and stable on the face.

This cannot be done properly by the wearer himself; it should be carried out by a second person in the following manner:—

Operation 1.—*Preliminary.*

First slacken off all the elastic bands of the headharness, so that the ends are about one inch from the buckles, and then instruct the wearer to put on the respirator. If spectacles are worn they should first be removed. Then, while the respirator is in position on the face, tighten each of the elastic bands so that the facepiece is drawn into firm, but not uncomfortable, contact with the skin and, as near as can be judged, all the bands are exerting an equal pull. Make certain that the wearer's chin is fitting closely into the chin of the facepiece.

Operation 2.—Observe if the size is correct.

The size of the respirator is generally correct if the wearer's eyes appear roughly midway between the top and the bottom of the eyepieces. If the eyes are very much *below* the centre of the eyepieces in a NORMAL size, it must be exchanged for a SMALL size. Conversely, if the eyes are very much *above* the centre in a SMALL size, a NORMAL size is required. If the face is very abnormal, and the eye positions are not satisfactory in either size of respirator, the size adopted should be that which fits the more safely and comfortably when the headharness has been properly adjusted as described below.

Operation 3.—Adjust the headharness.

The facepiece of the respirator is made of soft and flexible rubber so that it will naturally tend to shape itself to the face and make close contact with the skin without using strong pressure. It is not necessary, therefore, to wear the headharness very tight in order to obtain a gastight fit; in fact, if the elastic bands are drawn too tight they may actually cause leakage by stretching the rubber and so prevent it from taking the shape of the face. The headharness should be no tighter than is needed to hold the facepiece firmly on the face during the carrying out of all duties, without causing discomfort.

(i) Instruct the wearer to move the head fairly vigorously in all directions and note if the facepiece slips on the skin. If it does so, all the elastic bands should be gradually tightened until the respirator is firm.

(ii) Next instruct the wearer to bend the head slightly forward and nod several times. The facepiece should neither slip down on the face nor the point of the chin jump out of the chin pocket. If either of these movements occurs, the two top elastic bands which pass over the crown of the head should be tightened.

(iii) Now grasp the respirator with one hand round the string binding which secures the container into the facepiece, and attempt to pull it gently away from the face. If the facepiece is felt to leave the chin easily, the two bottom elastic bands which pass under the ears should be tightened until the wearer can feel no movement away from his chin when the container is thus pulled.

(iv) Ask the wearer to confirm that the respirator is comfortable and is not pressing unduly at any point.

Operation 4.—Test for gastightness.

Now that the respirator has been comfortably fitted it must be tested to make sure that no air can leak in between the facepiece and the face. Grasp the respirator with one hand round the string binding which secures the container into the facepiece and place the palm of the other hand firmly over the circular opening at the end of the container so that no air can enter, taking care not to move the respirator on the face. Instruct the wearer to attempt to breathe in and to say if air is felt to leak in at any point around the facepiece. If any such leakage is reported it can often be confirmed by placing the ear close to the facepiece and listening for the hiss of the inrushing air. The exact position of the leak can be located by pressing the tips of the fingers lightly on the outside of the facepiece at the suspected point and noting when the leakage ceases. If leakage does occur at any point, the adjacent elastic band must be re-adjusted until the leakage ceases, remembering that the leakage *may* be due to excessive tightness of the elastic and that slight slackening off may allow the rubber to make better contact with the skin.

If the wearer normally uses spectacles, they may be worn under the respirator *provided that* it is ascertained with certainty that they do not cause

leakage at the temples. Most spectacles now in use are not suitable for wearing with a respirator because of this leakage, but on the majority of faces the type having thin wire frames may safely be worn. Thick horn spectacles are not likely to be safe. When the respirator has been fitted as described above, instruct the wearer to put on the respirator over his spectacles. Then repeat the test for gastightness. If there is no leakage, or if there is only a minute leakage when the breath is drawn in so strongly *that the face piece is sucked in against the face,* the wearer may use his spectacles with the respirator. A slight tightening or loosening of the elastic bands which are attached at the temples may be found to improve the fitting over spectacles, but no greater leakage than that described is permissible. The anti-dimming compound provided with the respirator must be used on *both* sides of the glass of the spectacles.

After the respirator has been worn for some time it may tend to fit farther on to the face due to the rubber facepiece becoming more pliable. If this occurs, and discomfort is caused thereby, the elastic bands of the headharness should be slightly loosened while the rubber is still warm on the face, and the test for gastightness repeated.

B.—The Use of the Civilian Duty Respirator.

It is assumed that the respirator has already been fitted to the wearer—that is, that the headharness is correctly adjusted to fit his head.

1. *General.*—The respirator is carried in the haversack at the left side of the body, with the sling over the right shoulder, and so that the tucks in the sling are to the front.

When the haversack is new, the sling is of suitable length for persons of small stature. For persons of larger stature it should be increased in length, by releasing one or more of the four tucks, so that the respirator hangs over the bone of the left hip. The tucks are released by carefully cutting the stitches.

2. *When it is known that there is no gas in the vicinity, or when there is no likelihood of gas being encountered,* the respirator is carried in the *NORMAL* position, which is as follows (*see* Fig. 12):—

Respirator in haversack.

Haversack tightly closed and whipcord loops tied together in a double bow.

Haversack at left side and as far round the back of the wearer's body as is convenient and comfortable.

3. *When the presence of gas in the vicinity is suspected, or when there is a likelihood of gas being encountered* (e.g., during an air raid) the respirator is to be carried in the *ALERT* position, which is as follows (*see* Fig. 13):—

Respirator in haversack.

Mouth of haversack opened to its fullest extent.

Haversack on left hip, and clear of all other equipment so that it can be readily swung to the front of the body.

4. *Immediately gas is encountered, or the alarm "GAS" received,* the respirator is to be put on as quickly as possible. Rapid protection can be obtained only by following the correct details of respirator drill, which are as follows:—

(i) Hold the breath.

(ii) With the left hand grasp the bottom of the haversack and swing it to the front of the body. With the right hand remove any headgear and place it between the knees (*see* Fig. 14).

(iii) Thrust the right hand into the mouth of the haversack, and take hold of the respirator round the outside of the string binding, which secures the container to the facepiece.

Withdraw the respirator with a smart movement and hold it up in front of the face ready for putting on (*see* Fig. 15).

FIG. 12—CIVILIAN DUTY RESPIRATOR CARRIED IN NORMAL POSITION.

FIG. 13—CIVILIAN DUTY RESPIRATOR CARRIED IN ALERT POSITION.

FIG. 14—CIVILIAN DUTY RESPIRATOR—ACTION ON ALARM "GAS", STAGE ONE.

FIG. 15—CIVILIAN DUTY RESPIRATOR—ACTION ON ALARM "GAS", STAGE TWO.

FIG. 16—CIVILIAN DUTY RESPIRATOR—ACTION ON ALARM " GAS ", STAGE THREE.

(iv) Insert the thumb of the left hand under the centre of the headharness (i.e., at the point where all the elastic bands meet), release the grip with the right hand and allow the respirator to hang by the headharness on the left thumb. Insert the right thumb alongside the left thumb and slide the thumbs wide apart so that the elastic between them is stretched and the respirator is suspended by the middle and bottom elastics on each side (*see* Fig. 16).

(v) Thrust the chin forward into the chin of the facepiece and draw the facepiece on the face by passing the headharness smartly over the head with the thumbs.

(vi) Breathe out and continue breathing in a usual manner.

(vii) Adjust the respirator squarely and comfortably on the face and run the fingers over the facepiece to make sure that the edges are not doubled inwards, or the elastic bands twisted. The centre of the headharness should rest on the back of the head.

(viii) Replace headgear (*see* Fig. 17).

In the case of men wearing caps, helmets, or sou' westers with the chinstraps down, the head-dress should be removed and hung on the left forearm until the adjustment of the respirator is complete, when it should be replaced with the chinstrap at the back of the head.

IMPORTANT.

When removing the respirator from its haversack, it should never be withdrawn by pulling on the container itself. This might lead to breakage of the joint between the facepiece and container.

5. *When it is thought that gas may no longer be present,* the air must be tested for gas before the respirator is taken off. First take a fairly deep breath,

FIG. 17—CIVILIAN DUTY RESPIRATOR FULLY ADJUSTED AFTER ALARM "GAS".

then insert two fingers of the right hand between the cheek and the facepiece and lift it slightly away from the face. Sniff gently. If gas is detected, or *if there is any doubt,* replace the facepiece at once and breathe out strongly to blow out any gas which might have leaked in during the test.

6. *When the air is known to be clear of gas,* the respirator may be removed. Raise the headgear with the left hand, insert two fingers of the right hand under the chin of the facepiece and lift the respirator off with an upward and backward movement over the head. Replace headgear (with the chinstrap under the chin in the case of men wearing caps, helmets or sou'westers with the chinstrap down).

7. *After using the respirator,* the inside of the facepiece should be wiped dry with a clean cloth before it is put away. If possible, the eyepieces should also be treated with anti-dimming compound so that the respirator is ready for the next emergency, but if conditions do not permit of an immediate treatment *the first available opportunity of doing so must be taken.*

To Replace the Respirator in the Haversack.

Hold the respirator in the right hand, thumb on one eyepiece, fingers on the other, with the container in the palm of the hand.

Fold in the forehead portion so that it separates the eyepieces.

Squeeze the eyepieces together and replace the respirator in the haversack, forehead portion first, harness buckles to the wearer's right.

To Adjust a Civilian Duty Respirator on another Person.

The instructions given in respect of a Service respirator at the end of Appendix B will apply equally to a Civilian Duty respirator, except that there need be no adjustment of the haversack.

§23] APPENDIX D.

Station or Depot for Air Raid Precautions Services.

The accommodation described in this Appendix is intended to be applicable to all services which would be liable to be exposed to serious concentrations of gas—police, fire brigades, first aid parties, rescue parties, decontamination squads, and so on.

It is assumed that these facilities will be incorporated or improvised in existing buildings—police and fire stations, highway depots, etc. Space for the purpose should where possible be provided in new buildings when they are erected.

The facilities required consist essentially of three rooms (undressing, washing and dressing), though the existence of a fourth for minor first aid treatment might be a useful addition, and it is desirable that there should be an open shed or verandah outside the premises in which contaminated outer clothing can be left before the wearer enters the building at all. Where the staffs include both sexes, two sets of rooms will be required.

Sketch plans of the lay-out for this accommodation are given in Fig. 18. The following notes explain the requirements:—

Room 1 (Undressing) should have easy access from outside. If contaminated outer clothing can be taken off in an outside shed or verandah it will only be necessary to have the usual air lock at the entrance (*see* Fig. 18A). Where outside accommodation is not available, and outer clothing is discarded in the undressing room itself, this room and any passage which leads to it may accumulate vapour from contaminated clothing, and should be isolated from the rest of the building by an air lock between Rooms 1 and 2 (*see* Fig. 18B).

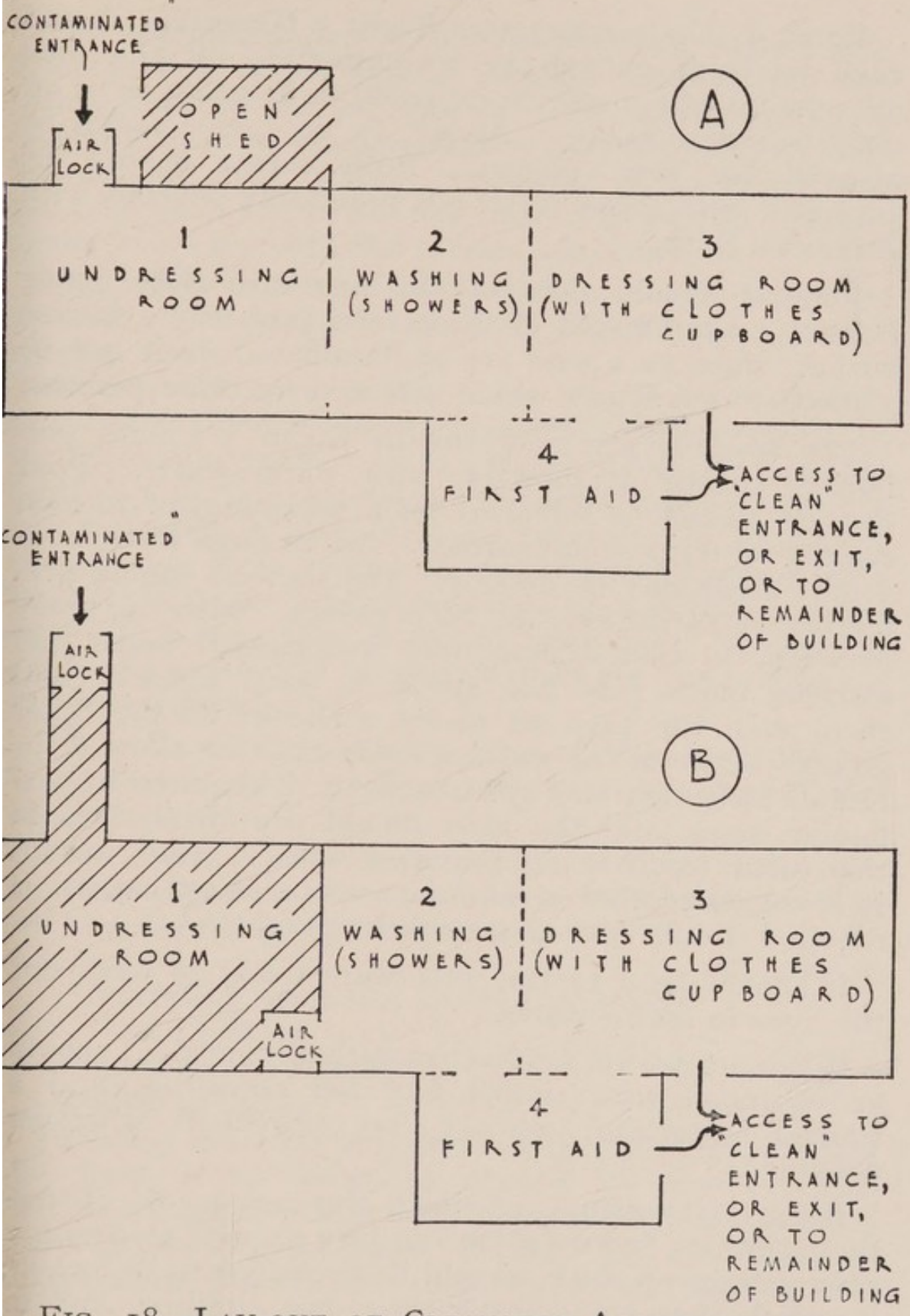

FIG. 18—LAY-OUT OF CLEANSING ACCOMMODATION FOR A.R.P. SERVICES.

The shading shows portions in which gas vapour might collect.

Room 1 (Undressing) and Room 3 (Dressing) should each be large enough to accommodate all the men (or women) who might be expected to be going on or off duty simultaneously. About 15 sq. ft. should be allowed for each person. Both rooms should be equipped with forms to sit on, preferably covered with American cloth.

Room 1 should also contain bins with close fitting lids for contaminated clothing, and probably a latrine bucket, since men who are contaminated must not be allowed to use w.c.'s which are used by other persons.

The washing arrangements in Room 2 should preferably consist of showers, with warm water. Four showers should be sufficient for a maximum of 20 men coming off duty simultaneously, but in large stations or depots more may be needed. The showers should preferably be arranged in two groups, with a space between, so that a man may wet himself under one shower, move into the space to soap himself, and then wash the soap off under a shower in the other group. Space in the washing room must be allowed for bleach treatment and eye treatment, if required in particular cases, and the men should dry themselves in this room (each being provided with a clean towel). It is suggested that a minimum space of 175 sq. ft. is required if only four showers are provided.

It should be a routine procedure freely to wash out the eyes in warm water.

When a separate first aid room is provided, it should be equipped with simple first aid requisites, and a trained attendant should be provided whereve possible.

Room 3 (Dressing), in which the men would change their clothing before going on duty as well as dressing after coming off duty, should have cupboards or lockers in which they could leave their own clothing, and in which *clean* protective clothing could be kept until required.

The accommodation should be provided with a permanent staff, which should include, according to the number of the parties, two or more undressers (who must themselves wear respirators and protective clothing) and one man, or more, trained in giving bleach and eye treatment and minor first aid. The precise arrangements will vary with the service concerned.

The whole accommodation should be gas-protected so that it could be used even if gas were present outside.

An essential point is that there should be a separate *entrance* for contaminated personnel leading direct to the undressing room. All the rooms should, if possible, lead out of one another. Separate *rooms* are not essential, and it may often be necessary to divide up one or two large rooms to meet requirements. If a separate entrance and exit cannot be arranged in each room it is desirable to erect temporary barriers to avoid the possibility of contact between those entering and those coming out.

There should be a bleach tray at the contaminated entrance in which each person entering should first wipe his boots.

The average time required for dealing with contaminated persons after work may be reckoned at 25 minutes, made up as follows:—

	Minutes.
Undressing, including removal of protective clothing	5
Washing and drying	10
Dressing	10

Drainage must be provided where necessary. When the floor is of wood, it should be covered with lead or linoleum, which should preferably be extended some distance up the walls. It may best be placed on a false floor, raised some three inches and sloping into an improvised gutter. If the floor is of concrete, it should be treated with sodium silicate solution (one part of water glass to four parts of water).

The ideal construction of the undressing room is t have the lower part of the walls lined with glaze tiles or bricks, and the floor of waterproof cement o concrete provided with a drainage system, so that de contamination by hosing down can be carried out easily The walls will be less liable to contamination than th floor, and almost any type of wall will serve so lon as it is washable. Plain plaster walls can be rendere more suitable by treatment with a silicate paint o washable distemper or by covering with washable paper Papered walls and woodwork can be similarly treate or else varnished.

The floor, being more liable to contamination, shoul be made as impervious as possible, and will need t be hosed down frequently to remove contamination

The essential points are to avoid, as far as possible the use of porous materials, to protect, in one of th ways mentioned above, any porous materials whic cannot be eliminated, and to wash them thoroughl as soon as possible after use.

Good ventilation is desirable for the removal of an gas which may evaporate from the clothing. Venti lation will have to be stopped if gas is present in th atmosphere outside the building unless a ventilatio system fitted with a special filtration unit has bee installed.

Facilities will be required for hanging out, in som suitable yard, the protective suits which have bee exposed to vapour, and for boiling such suits as ar contaminated with liquid. There will be a good dea of equipment to decontaminate in this way—jackets trousers, hoods, boots and respirator facepieces. I necessary, a suitable boiler of the "copper" typ should be installed under a lean-to shed. This wi allow the free escape of contaminated steam while th articles are being boiled.

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