Personal protection against gas / issued by the Home Office (Air Raid Precautions Department).

Contributors

Great Britain. Air Raid Precautions Department.

Publication/Creation

London : H.M.S.O., 1938.

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In addition to these Handbooks, there is 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 (see list on back cover).

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 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

1st Edition, August, 1936. (477,000 copies.)
2nd Edition, March, 1938.

LIST OF ILLUSTRATIONS

GLOSSARY OF TECHNICAL TERMS.

Air-lock ... ... A compartment or lobby at the entrance to a gas protected building or room 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 charcoal to absorb true gases and the particulate to prevent the passage of finely divided particles of smokes, etc.

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. This word is not used to describe the cleansing of *persons*.

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.

INTRODUCTION

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.

Individual protection, which consists in the wearing of a respirator and possibly anti-gas clothing, is fully described in this book.

Collective protection against gas consists in resort to a room or refuge which has been protected against the entry of gas. In this way the use of respirators and other methods of individual protection is rendered unnecessary so long as the gas-protection of the room or refuge remains undamaged. Collective protection is therefore to be regarded as the first line of defence for those not required to be out of doors on duty, and the respirator as the second line.

Methods of gas-protecting buildings are not dealt with in this book because they are closely bound up with protection against splinters and blast, and the whole subject is covered in other publications.

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

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

These gases are often called "lachrymators."

(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) *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."

(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 also known as " vesicants."

No immediate pain is felt on contact with mustard gas in the solid, liquid or vapour form, 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) Tear gases

(*i*) **Chlor-aceto-phenone (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-iodo-acetate (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*) **Bromo-benzyl-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.

(b) Nose irritant gases

Di-phenyl-chlor-arsine (D.A.) *and similar compounds, such as* **di-phenyl-amine-chlor-arsine (D.M.)** *and* **di-phenyl-cyano-arsine (D.C.)** (*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 may not subside, and may seem to increase, on first removal into pure air, or on putting on the respirator; but they are nevertheless 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) 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 waterlogging of the lungs. 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 then 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.

(d) Blister gases

(*i*) **Mustard gas** (ββ'—*di-chloro-di-ethyl sulphide*) (*Persistent*).—This substance is an oily liquid, probably dark brown in colour, with a faint but characteristic smell. Some people consider this smell like mustard, others associate it with horseradish, onions, or garlic. Some persons cannot detect the smell except in high concentrations.

It is readily soluble in certain liquids such as oils, 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 when brought in contact with the body.

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

(*ii*) **Lewisite** (β—*chloro-vinyl-di-chlor-arsine*) (*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, and can therefore have a much thinner steel casing than that of a 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 in an effective concentration may be considerably 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 risk 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. Detection of the various Types of Gas

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 blister gas contamination.

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

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

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.

9. 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 greenish yellow paint which shows a red discolouration 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. These should be not less than about 18 inches square. Their purpose is to indicate rapidly the arrival of aircraft spray.

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

It should be noted that certain liquid tear gases, such as K.S.K. and B.B.C., also produce a reddish discolouration similar to that resulting from blister gas. These tear gases may be present when efforts are being made to detect blister gas, but they can be readily recognised by their powerful effect on the

eyes. When, therefore, tear gas is present it must be remembered that any colour change produced in the detector paint is not a certain indication of the presence or absence of blister gas. Similarly, when the presence of tear gas is indicated by smell, it must not be assumed that a red discolouration is due to the tear gas only, since blister gas may have been used in addition and the strong smell of the tear gas may be masking its presence.

The detection of the red colouration of the paint may also be rendered difficult by mud, or even by the brown liquid of mustard gas itself.

In view of this limitation, any indications given by these detectors should be considered in conjunction with other observations made on the lines described in the preceding Sections.

CHAPTER IV

GENERAL ANTI-GAS PRECAUTIONS AND COLLECTIVE PROTECTION

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 refuge, unless your public duty compels you to go out of doors or remain at work in an unprotected place.

(ii) Have your respirator always with you.

(iii) Do not come out of the room or refuge 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 5 to 7 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.

It should be remembered that outside walls, door-posts, lamp-posts and similar objects may be contaminated after a raid in which blister gas has been used, and care should therefore be taken not to touch or lean against them until they have been decontaminated.

Leather boots may be a source of danger, and are quite unsuitable for use in heavily contaminated places. When leather boots have unavoidably to be used in contaminated localities, they should first be thoroughly greased with a mixture of equal parts of bleaching powder and white petroleum jelly, such as vaseline just before being worn. This mixture will help to delay the penetration of blister gas into the leather, and should be wiped off when the boots are taken off before coming indoors. A fresh application should be made each time the boots are worn. To obtain the maximum protection with leather boots, only those with sound and thick soles should be used.

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 blister 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 blister gas, taking care while doing so that they do not contaminate their hands. If any trace of blister gas can be seen or smelt the boots must not be worn, and must be left out of doors until decontaminated (see Section 27).

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. (This must not however be done if contaminated gloves are being worn).

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. Collective Protection in Buildings

Gas-protected accommodation should be regarded as the primary protection against gas for those whose duty does not compel them to be out of doors or to remain in an exposed place. This may take the form of a refuge-room at home or at their place of business, or a shelter or public refuge, depending on where they are. It is therefore an integral part of anti-gas training to know how to protect a room or shelter against gas. In ordinary buildings this can be done comparatively simply.

Methods of gas protection are described in the handbook "The Protection of Your Home against Air Raids," and in A.R.P. Handbook No. 6 "Air Raid Precautions in Factories and Business Premises," the relevant parts of which should be consulted by those concerned with anti-gas training.

Collective protection in gas-protected accommodation is a first line of defence against gas, but those provided with respirators should also have them at hand in case the gas protection is damaged. The design and use of respirators is described in the next Chapter.

CHAPTER V

PROTECTION OF THE EYES AND LUNGS

The respirators which are described in this Chapter have all been designed to give protection against all types of gas which are likely to be used as war gases. The protection which they give against these gases is fully satisfactory, but it must be emphasized that they are not intended to afford protection against other gases which may be encountered in industrial processes or in everyday life. They do not, for example, protect against carbon monoxide which is present in coal gas, exhaust gases from motor cars and gases from sewers or drains, nor from petrol vapour in confined spaces, ammonia or similar toxic and noxious gases and vapours. These respirators should not therefore be relied upon for protection in the presence of peacetime dangers. In any event, they will not render the wearer safe in situations where the danger arises from a deficiency of oxygen.

Care must always be taken not to damage respirators by careless handling, or their efficacy may be inpaired. The instructions for their use and care must always be carefully observed.

13. The Civilian Respirator

The Civilian respirator must be described first, because it is the respirator intended for use by members of the general public, and a knowledge of it is required by everyone. Even those whose duties would require them to wear the Civilian Duty or Service respirator when at work must remember that they themselves when off duty, and their families in any case, would have to wear the Civilian respirator.

The Civilian respirator protects the wearer against breathing any of the known war gases and is to be used on occasions when gas is present and a gas-protected room or refuge is not available or has to be evacuated.

This respirator (*see* Fig. 1) consists essentially of:—

(i) a container filled with material to filter or absorb gas; and

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

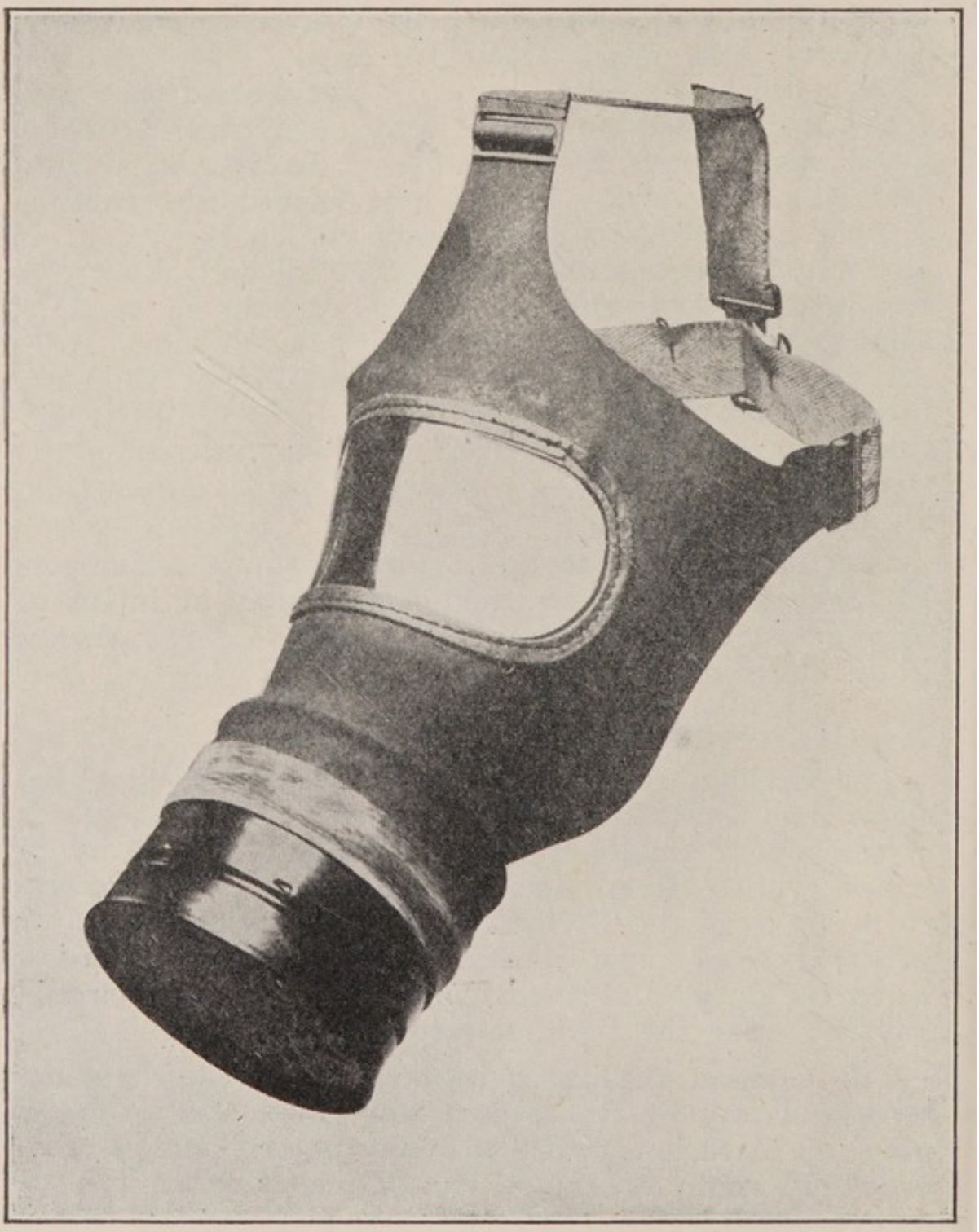


FIG. 1—CIVILIAN RESPIRATOR.

The facepiece is made of rubber sheet, with a large window of non-inflammable transparent material. (This material might be damaged by the chemicals in many types of disinfectants and, as is mentioned in Appendix D, even the disinfectants approved for use with other respirators should not be used on the Civilian respirator.) The cylindrical container is securely attached to the facepiece by means of a strong rubber band. All the air breathed by the wearer passes through this container, which removes the poisonous gas.

No haversack is provided with this respirator, but it is issued in a stout cardboard carton which should be kept to preserve the respirator from damage.

The respirator covers the entire face and is held in position by means of three straps attached to the facepiece which meet in a buckle at the back of the head. By suitably adjusting the length of the straps a respirator of the appropriate size can be made to fit comfortably on any head. A safety pin is provided in the end of each strap so that when once the straps have been adjusted to the correct length they can be made secure against unintentional alteration by pinning the ends to the body of the straps.

When the respirator is worn the air drawn in through the container passes into the facepiece through a simple one-way valve attached to the inner end of the container. This valve closes on breathing out, thus preventing air being passed back through the container, and the pressure of the breath then lifts the edge of the facepiece very slightly away from the face at the cheeks and allows the breath to escape.

The respirator is made in three sizes. The difference between the sizes lies only in the size of the facepiece: the same container is fitted to each size.

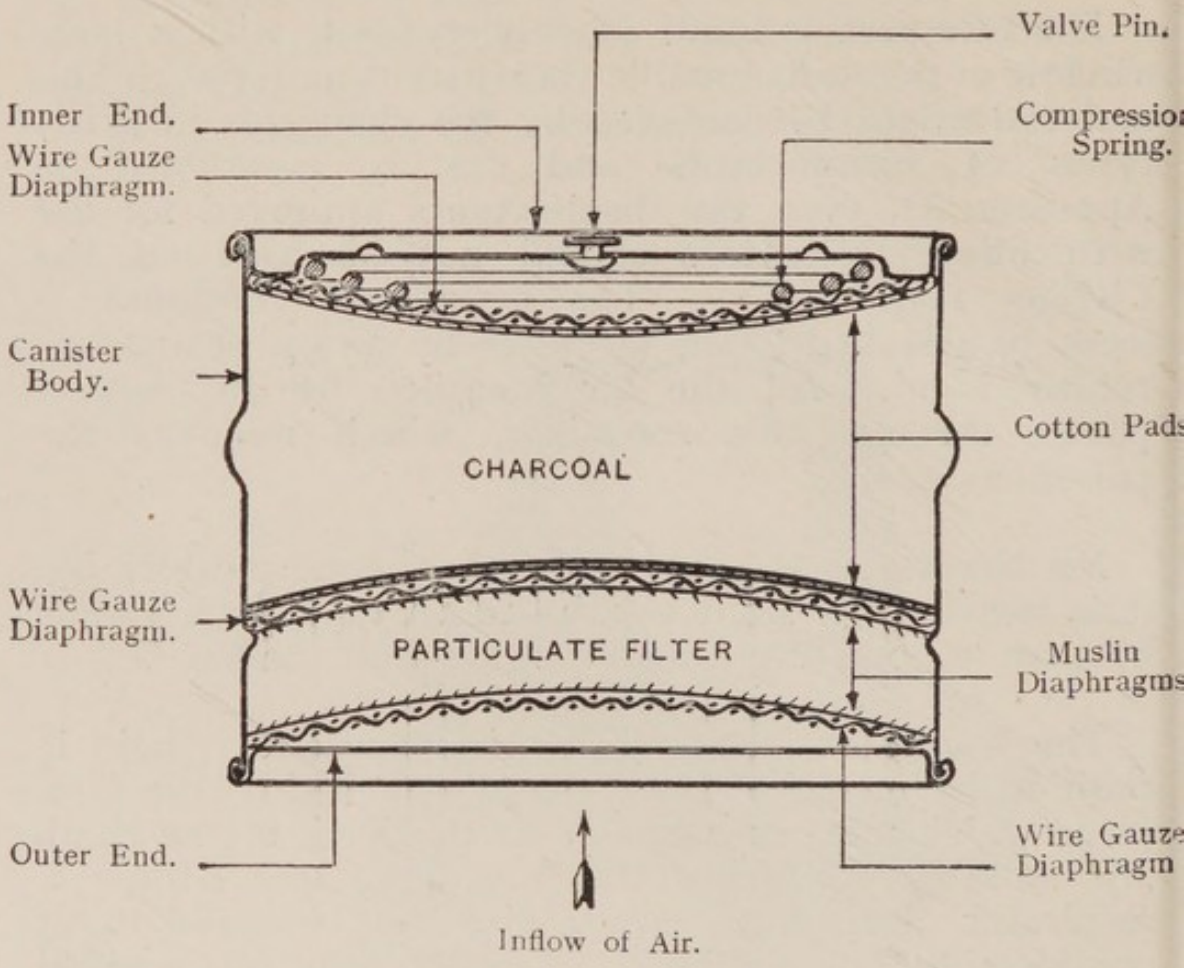


FIG. 2—CIVILIAN RESPIRATOR CONTAINER (G.C. Mark II)

The container (known as G.C. Mark II—*see* Fig. 2) consists of a cylindrical tin canister (lacquered black) containing activated charcoal to absorb gases such as phosgene and mustard gas, and a particulate filter which prevents the passage of finely divided smokes like the arsenical gases. The contents of the container do not deteriorate either with age or with wearing the respirator when gas is not present. When used in gas the contents of the container slowly become exhausted, the rate of exhaustion depending upon the concentration of the gas and the length of time of wearing in gas, but the nature and amounts of the contents are such that the container will remain efficient for a very long time under the conditions in which it will be used by the general public.

When the respirator is issued for use in time of emergency it must first be fitted to the face of the person who is to wear it. It will then become the personal property of that person and it will be his or her duty to become familiar with the proper method of wearing and taking care of it.

Dimming

In order to prevent the eyepiece misting over when the respirator is worn, treat it as follows:—

(i) If the eyepiece is smeary or opaque as the result of previous wearing, sponge the inside lightly with clean water before applying the treatment described in (ii) below.

(ii) Wet the end of a finger and rub it on a piece of toilet soap. Then rub the finger all over the inside of the eyepiece so that a thin even film of soap covers the surface. The respirator is then ready to wear.

Use *toilet* soap only for this treatment.

(iii) Treat the eyepiece as described above when the respirator is removed, so that it will be ready for immediate use again. If the respirator is not worn, the soap film will remain effective for about one week.

(iv) If the film of soap is rubbed or scratched its efficiency will be impaired, so in order to obtain the best possible vision it is advisable whenever possible to treat the eyepiece immediately before use.

The Civilian respirator being worn is illustrated in Figure 3. Instructions as to its fitting and use are contained in Appendix A.

FIG. 3—CIVILIAN RESPIRATOR BEING WORN.

14. The Care of the Civilian Respirator

The respirator has been designed to withstand for a long time the wear due to ordinary use. Reasonable precautions must, however, be taken to preserve it in good and safe condition. The respirator should be regarded as a personal article upon which the wearer's safety may at some time depend, and it should be treated with the care to which such a safeguard is entitled. Apart from considerations of personal safety, economy of respirators would be most important in war, and it is particularly desirable that the many respirators which would never have to be used in gas should not have to be replaced on account of accidental or careless damage.

Careful attention to the proper method of putting on and removing the respirator will very greatly help in preserving it from damage. The wearer should take steps to become familiar with these operations and with wearing the respirator so that in an emergency, when haste may be necessary, damage to the respirator is not likely to be caused through ignorance or lack of practice in using it.

When not in use the respirator should be kept in a cool place away from strong light. Exposure to heat or prolonged exposure to strong light will cause deterioration of the materials from which the respirator is constructed and must be avoided. For instance, the respirator must not be dried before a fire or kept near a radiator or left standing on a window ledge.

If wet with rain the respirator should be dried with a soft cloth before being put away, taking care not to scratch or crease the transparent window.

After use the respirator will be wet on the inside with moisture from the breath. This moisture should be wiped out with a soft cloth and the inside of the respirator allowed to dry before it is put away.

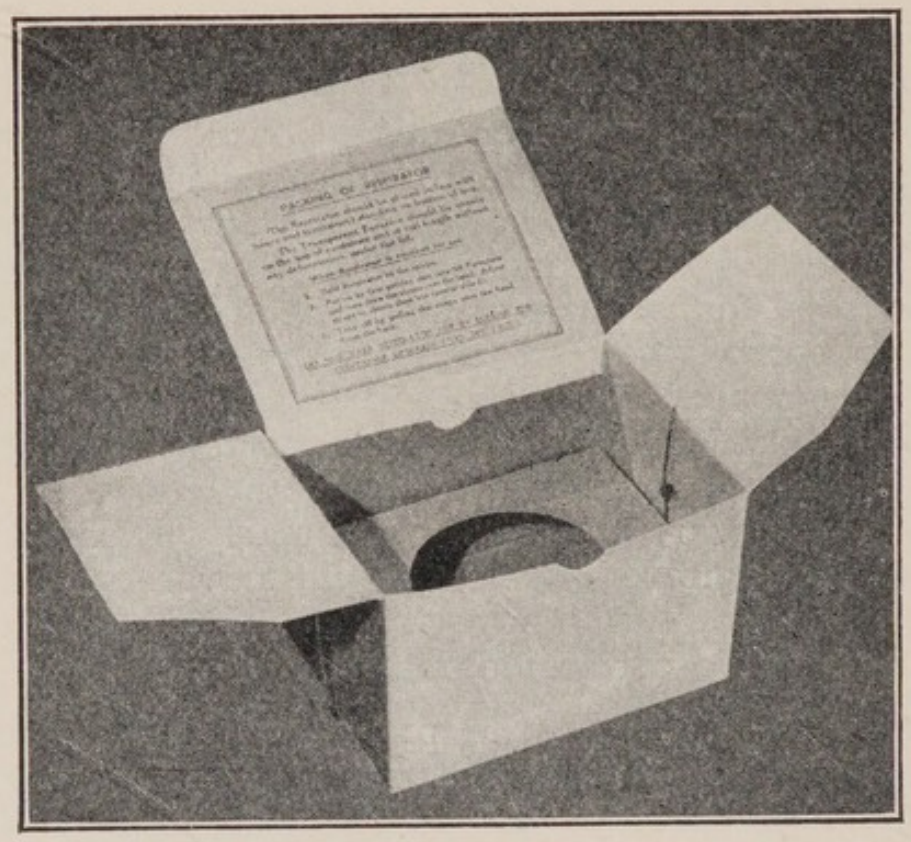


FIG. 4.—CIVILIAN RESPIRATOR CARTON, SHOWING RECESS FOR CONTAINER.

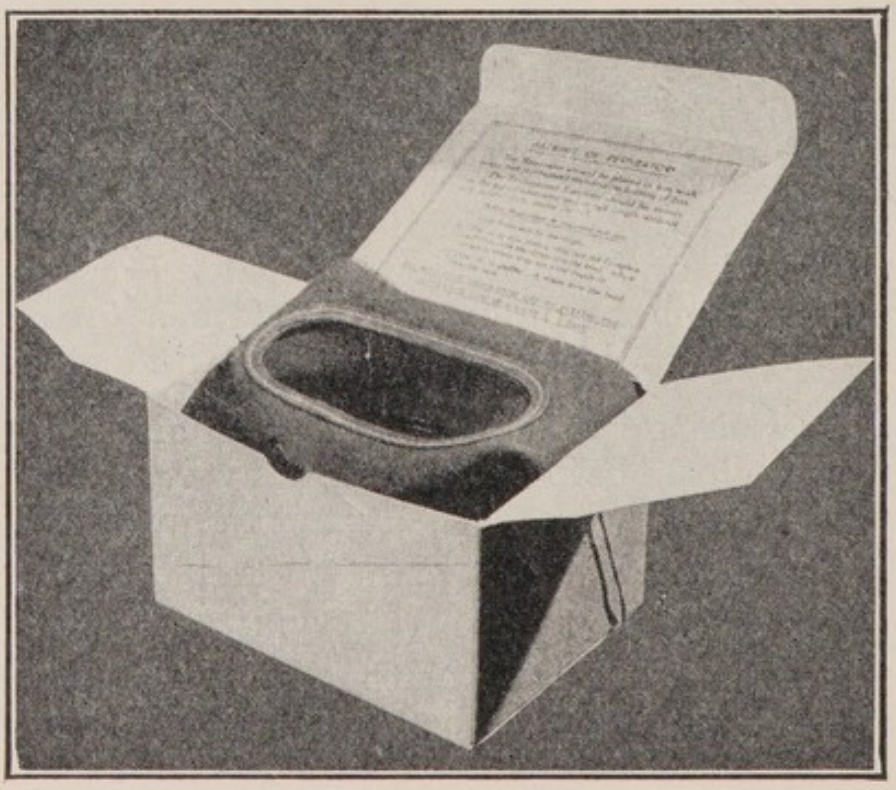


FIG. 5.—CIVILIAN RESPIRATOR CORRECTLY PACKED IN CARTON.

The respirator should not be carried or hung suspended from the straps, for this would tend to weaken the rubber and might prevent the respirator fitting properly when it is next put on. When not actually in use it should always be kept and carried in the cardboard carton provided (*see* Fig. 4). It should be inserted with the container standing upright in the recess at the bottom of the carton, the facepiece being laid over *so that the transparent eyepiece lies evenly on the top of the container at full length, without any deformation* (*see* Fig. 5).

Care must be taken at all times to avoid damage to the transparent window. It must not be allowed to become creased, folded, scratched, or dented, or unnecessarily exposed to heat.

In order to maintain the respirator in a wholesome condition the inside of the facepiece and the top of the container may be sponged carefully with a sponge or soft cloth which has been dipped in luke-warm soapy water and squeezed free from excessive liquid. Only soap of toilet quality is to be used for this purpose and the water must not be hot. The soap must then be removed by sponging with clean water. When sponging the eyepiece, it must be supported on the outside with the palm of the hand. Care must be taken not to use an excessive amount of liquid, and no liquid must be allowed to enter the container or to remain between the rim of the container and the facepiece.

As to the disinfection of the Civilian respirator, see Appendix D. For its decontamination, see Section 28.

15. Inspection of Civilian Respirators

The following points should be included in the inspection of Civilian respirators.

(a) *Facepiece*

1. The rubber facepiece must not be perished, torn or punctured. The rubber is in serviceable condition

if it does not tear when a portion of the edge is gripped between the fingers and thumbs, with their tips about 1 inch apart, and stretched to a length of about 2 inches. Punctures can be detected by holding the facepiece up to the light and stretching the rubber gently.

2. The stitching by which the tapes are attached to the facepiece must be sound and the attachment secure.

3. The transparent window must not be torn, punctured or split and the stitching around its edge must be secure. If the window is creased the crease must be carefully examined for small perforations or splits.

4. The seam at the side of the facepiece must be secure and the stockinet strip firmly stuck down to the rubber.

5. The safety pins on the head harness must be present and in usable condition.

(b) *Container*

6. The container must show no signs of perforations, heavy denting or entry of water.

7. The inlet valve must not be perished or stiff and it must seat properly so that when the wearer breathes out it effectively prevents the breath from passing back into the container. If the valve is stiff or has lost its elasticity it must be replaced, but if it is curled up but still soft it can be removed from the stud, turned over and replaced.

(c) *Rubber Band and Assembly of Respirator*

8. The rubber band must not be perished, torn, nor showing surface cracking. Its condition can be judged by lifting it with the finger and thumb at one edge and testing its elasticity. While the rubber band is thus lifted it must be verified that the position of the container is correct according to the size of facepiece.

The correct positions are as follows:—

Large facepiece—edge of rubber just over the raised swage in the container body.

Medium and small facepieces—edge of rubber just up to the raised swage in the container body.

The rubber band must be positioned so that its centre lies over the edge of the rubber of the facepiece. If the rubber band is in good condition it will return on to the container with a pronounced snap when it is released after the above inspection.

Note.—The container should not be removed from the facepiece unless there is definite reason to suspect a fault which cannot otherwise be investigated.

16. 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 highest concentrations.

The basic design (*see* Fig. 6) is the same as that of the Civilian respirator. The container is directly attached to the front of the facepiece.

There are three patterns of container in existence:—

(i) C.D. Mark I: a container made from a waterproofed cardboard cylinder on to which two light metal ends are seamed. Inside are activated charcoal and a particulate filter to prevent the passage of arsenical smokes. This pattern has a one-way valve at the outer end which is the inlet valve of the respirator. The inner end of the container is of perforated metal, and as this might be liable to become infected from the wearer's breath, and disinfection would be difficult without damaging the filters inside, an absorbent pad is

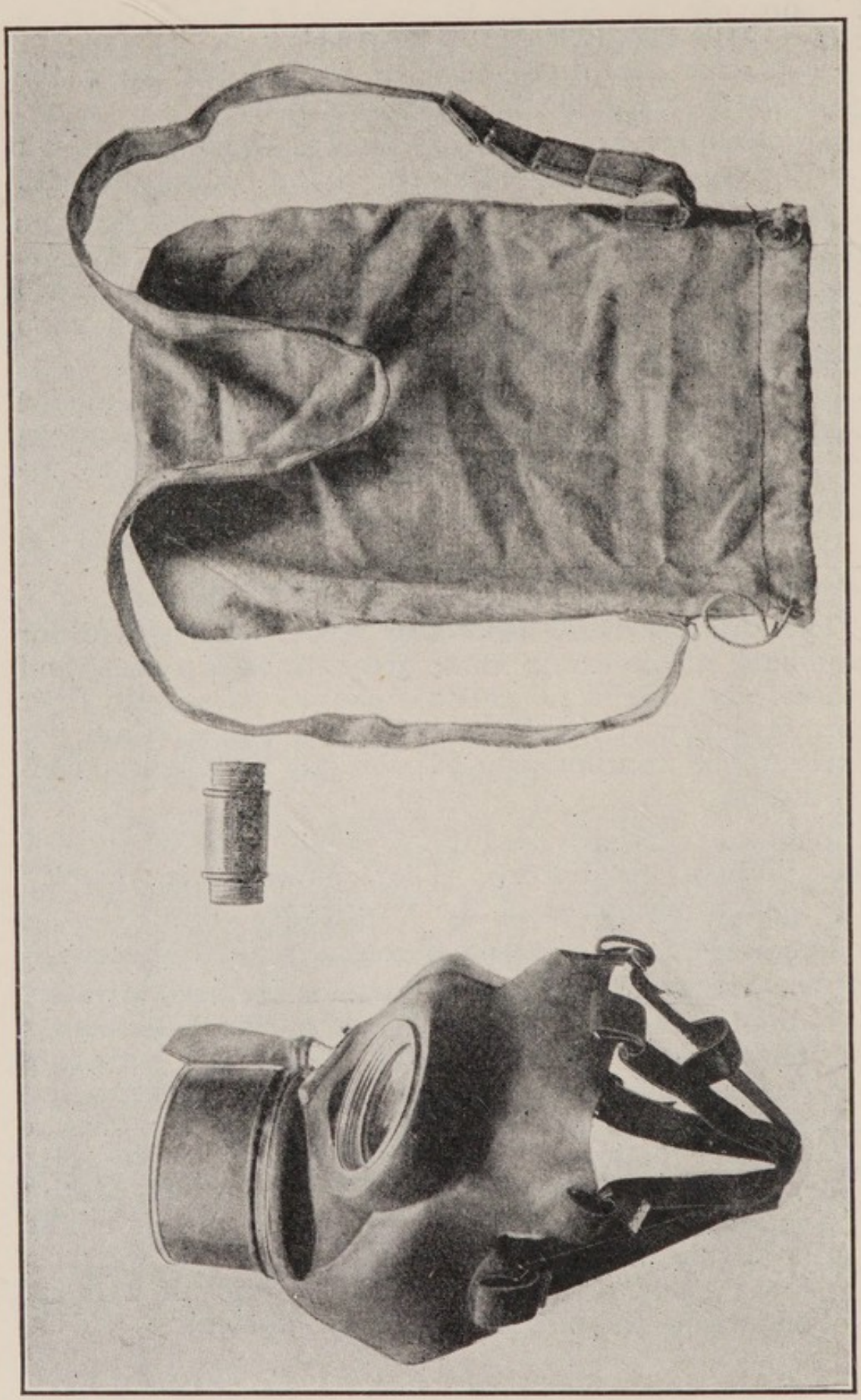


FIG. 6—CIVILIAN DUTY RESPIRATOR AND HAVERSACK.

provided and held with an annular spring clip, to protect the container from infection. When the respirator is disinfected this pad is thrown away, and a new one inserted.

(ii) C.D. Mark II: a container identical with Mark I except that the whole body of the container is of metal, lacquered black.

(iii) C.D. Mark III: an improved and slightly larger container, which is in fact identical with the container of the Civilian respirator except that the charcoal in it has a higher degree of activation. The main effect of this difference is that the container can absorb more gas before becoming saturated—i.e. that its effective life in use is longer. In this container the inlet valve is at the inner end, and can itself be disinfected, so that no absorbent pad is required as in the case of Mark I and II patterns. The Mark III container is distinguished from the Civilian respirator container by having a red band round the black lacquered body.

The facepiece is of stouter construction than in the case of the Civilian respirator (G.C. Mark II), to withstand harder wear. It is made of rubber, moulded to fit closely to the face. It is fitted with an outlet valve, and has a protuberance on the left cheek to which a microphone can be attached for those regularly employed on telephone work.

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 a metal band, or, in earlier examples, by cord.

The eyepieces are made of strong plain glass discs fitted into metal rims, and are removable by unscrewing for decontamination purposes. To prevent dimming, the later patterns of facepiece have also a thin disc

of gelatine-coated material inside the eyepiece. This is removable. When this gelatine disc is not fitted, particular attention must be paid to the application of anti-dimming compound.

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."

A small canvas haversack (*see* Fig. 6) 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. In Figure 7 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 B.

17. The Service Respirator

The Service respirator is the pattern of respirator issued to the Fighting Services. The protection it affords is of the same kind as in the case of the Civilian and Civilian Duty respirators, but the duration of its efficiency against gas is longer, and it has been designed to allow the wearer the greatest possible freedom of movement and the maximum use of his faculties. For instance, the weight of the container is carried on the chest and not on the facepiece, and special attention has been paid to the prevention of dimming of the eyepieces.

A—Slung. B—Adjusted.

Fig. 7—Civilian Duty Respirator.

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, first aid parties, decontamination squads, etc.).

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

The following types of container are being used, or will be used, with this respirator:—

Type A, in which the air enters the container through an inlet valve in the bottom of the

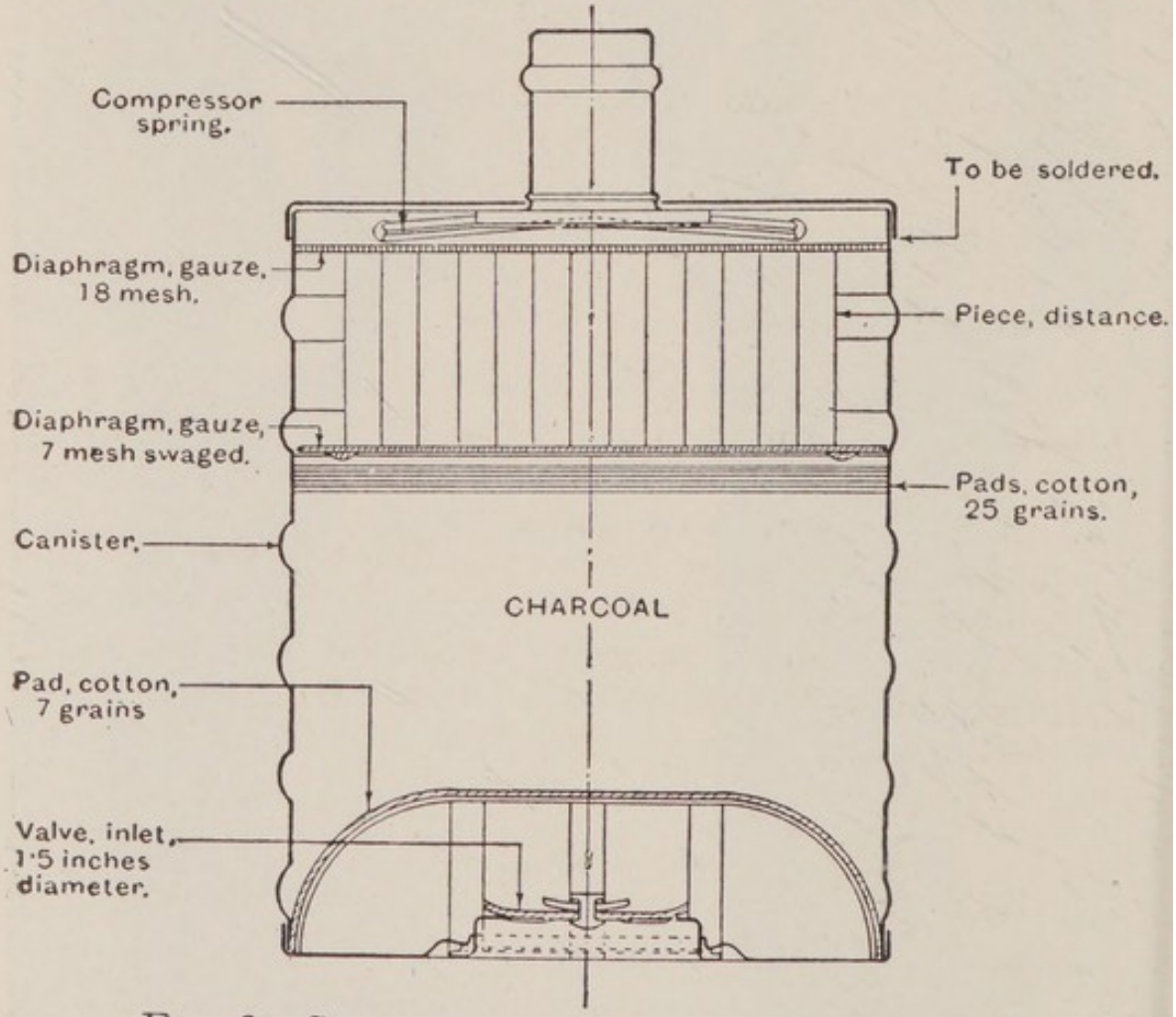


FIG. 8—SECTION OF CONTAINER OF SERVICE RESPIRATOR (TRAINING TYPE A).

canister. It is supported on a wire platform placed at the bottom of the container compartment of the haversack. The general construction of this container is illustrated diagrammatically in Figure 8.

Type D, in which the air enters through two inlet valves at the top of the canister. It is painted black with a distinguishing band of grey over the adhesive tape which seals the top of the canister to the body. The wire platform at the bottom of the haversack should be removed before inserting the container into its compartment. This process may be found a little difficult, because the fit is tight, but it can be accomplished with care.

Type E, in which the air enters through two slots in the side of the canister. It is painted a light yellowish brown. The wire platform should be removed from the haversack when using this container, and the slots should point towards the central partition of the haversack when the container is inserted into its compartment.

The internal construction of these three types is different, but the general principle on which they work is the same and is indicated diagrammatically in Figure 8. As regards efficiency they all give complete protection against non-persistent gases and the vapour of persistent gases, but the Type A container gives only a very limited protection against finely divided smokes, whereas the Type D and Type E afford adequate protection against these smokes.

The Type A container is intended for training purposes only, and would be replaced by a container of the standard of the Type D or E in the event of war.

If for any reason it becomes necessary to change the container, this can be done without difficulty.

The facepiece is made of rubber (sometimes covered on the outside with khaki stockinet) which is moulded to fit closely to the face. The gas-tightness of the respirator is dependent upon the closeness of this fit. It is held in position by elastic bands attached to the rubber which pass round the back of the head.

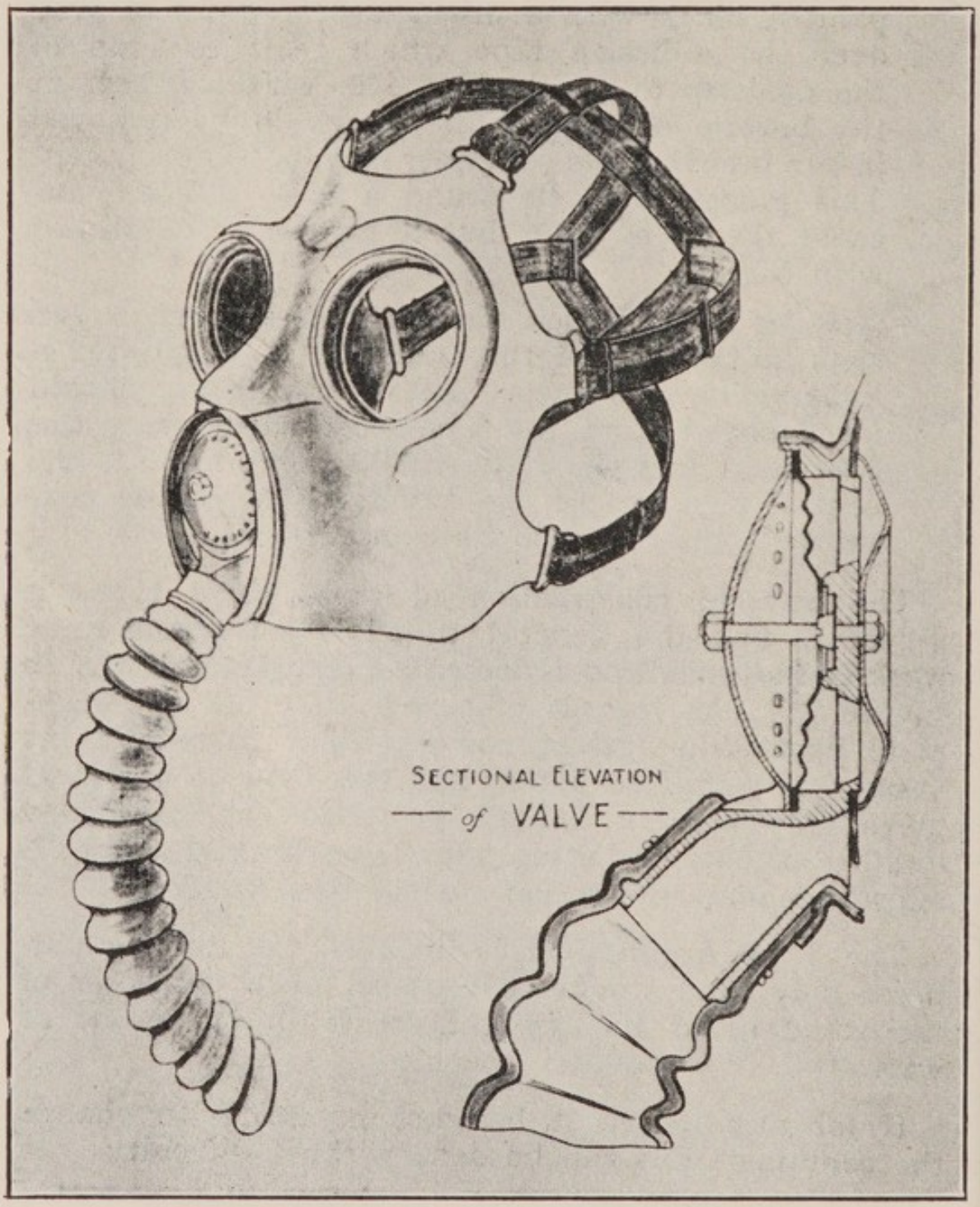


FIG. 9—FACEPIECE OF SERVICE RESPIRATOR.

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 Figure 9.

The eyepieces are made of splinterless glass. 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 (for the outlet valve) 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 as described for the Civilian Duty respirator (see Section 16).

The respirator is carried in a waterproof canvas haversack, the main part of which is divided into two compartments, one for the container and the other for the facepiece and anti-dimming outfit (*see* Fig. 10).

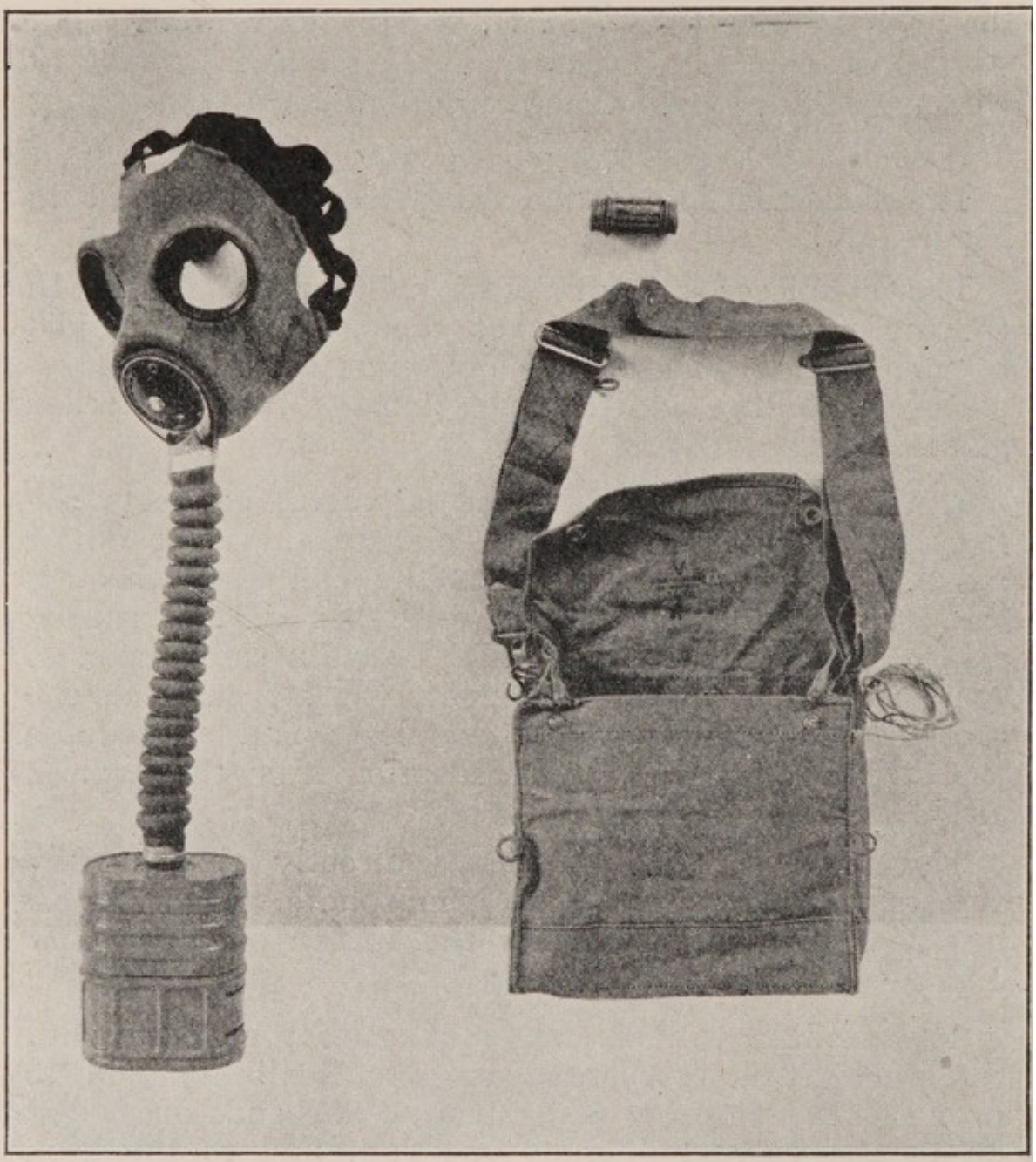


FIG. 10—SERVICE RESPIRATOR AND HAVERSACK.

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 Figure 11 A. There are two methods of attaining the

A—Sling Position. B—Alert Position.

Fig. 11—Service Respirator.

FIG. 12—SERVICE RESPIRATOR ADJUSTED, FRONT AND SIDE VIEWS.

" 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 C, and is illustrated in Figure 11 B. 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.

Figure 12 shows the respirator adjusted in the " gas " position, employing the standard " alert " position for the haversack.

18. The Care of Civilian Duty and Service Respirators

The general principles governing the care of Civilian Duty and Service respirators are the same as those already described for the Civilian respirator (Section 14). Owing to their different methods of construction the details to be attended to are different, and are described separately in this Section.

These respirators have been designed to withstand reasonable wear and tear during use, and if properly looked after, will last many years. Economy of respirators would be most important in war, and it is therefore essential that all to whom they may be 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 a folded condition 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 an approved disinfectant (see Appendix G), 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 with Mark I and II containers 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 contained in Appendices E and F.

(*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 headharness 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.

The processes for decontaminating Civilian Duty and Service respirators are described in Section 28.

19. Inspection of Civilian Duty and Service Respirators

Respirators in issue 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:—

CIVILIAN DUTY RESPIRATOR AND SERVICE 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.

CIVILIAN DUTY RESPIRATOR.

(4) 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.

(5) 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. If it 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. The lever lid carrying the valve in Mark I and II types may be removed for inspection of the valve.

SERVICE RESPIRATOR.

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

(7) The valve guard must not be damaged.

(8) 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.

(9) The container should show no signs of perforations, heavy denting or entry of water. The container neck should be securely attached to the body.

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 Mark I and II container. In the case of Mark III type the perforated end may be closed by holding a piece of smooth cardboard or rubber firmly against it. 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 sling, eyeletted canvas tab, S hook, 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

20. 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 some other blister gas. 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 blister 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 blister gas will have penetrated well into the skin and the damage will have been done.

21. Anti-Gas 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 blister 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 blister 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.

22. Patterns of Anti-Gas Garments

The various types of oilskin garments which have been adopted for A.R.P. services are as follows. The numbers in brackets are those of specifications prepared by the Technical Co-ordinating Committee on Textiles and Clothing, which (after the experimental stage) are published by H.M. Stationery Office.

(*a*) Jacket (Oilskin No. 1) anti-gas, heavy (T.C. 202).

(*b*) Trousers (Oilskin No. 1) anti-gas, heavy (T.C. 203).

(*c*) Hood, anti-gas (T.C. 226).

(*d*) Gloves, anti-gas (T.C. 225).

(*e*) Jacket, anti-gas, light (T.C. 229).

(*f*) Trousers, anti-gas, light (T.C. 229).

(*g*) Apron, anti-gas.

(*h*) Curtain, helmet, anti-gas.

In addition to the above oilskin garments the following anti-gas articles will be provided:

(*i*) Boots, rubber, knee. (T.C. 174.)

(*k*) Eyeshields (L.A.G. 1174).

(A steel helmet to protect the head against splinters, etc., will be worn with the anti-gas garments by services with duties out of doors.)

Persons likely to be exposed to contact with liquid gas, but not to severe concentrations of vapour, e.g., undressers at First Aid Posts, will wear

(*d*) Gloves, anti-gas (unless a satisfactory lighter type can be evolved).

(*g*) Apron, anti-gas.

This garment is sleeved and protects the arms and front of body against liquid but not vapour. Underclothing and a strong cotton suit or overall should be worn under it.

Persons not likely to be working for long in heavy concentrations of gas, but who nevertheless may require protection from both liquid and vapour will be provided with

The light anti-gas suit, which consists of

(*d*) Gloves, anti-gas.

(*e*) Jacket, anti-gas, light.

(*f*) Trousers, anti-gas, light.

(*h*) Curtain, helmet.

(*i*) Boots, rubber, knee.

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

There are certain categories of A.R.P. Services who may be required to carry out their duties in the worst concentrations of vapour in an area badly contaminated by liquid blister gas, e.g., decontamination squads. For these the maximum protection must be provided.

The full heavy anti-gas suit consists of the following:

(*a*) Jacket, anti-gas, heavy.
(*b*) Trousers, anti-gas, heavy.
(*c*) Hood, anti-gas.
(*d*) Gloves, anti-gas.
(*i*) Boots, rubber, knee.

Only underclothing should be worn under this suit.

A man equipped in the heavy anti-gas suit, but without the hood, is shown in Figure 13.

The hood, which is made of oiled fabric, is adjusted after the respirator is in position, to protect the exposed portions of the head and neck. Its use is only necessary when work has to be undertaken for prolonged periods in high concentrations of vapour, such as might be encountered in enclosed spaces, and it should seldom be necessary in the open air.

The eyeshield consists of a sheet of cellulose acetate which can be bent to suitable shape and fastened over the eyes by elastic bands passing round the back of the head. It is designed to protect the eyes against blister gas spray. Generally speaking it will be provided for services such as police and air raid wardens who may be expected to be in the streets at any time, but not for services such as decontamination and rescue workers who would remain indoors till summoned for duty and would then wear respirators.

The anti-gas helmet curtain is an oilskin veil, for attachment to the steel helmet, to protect the neck and ears against spray.

FIG. 13—MAN EQUIPPED WITH HEAVY ANTI-GAS SUIT, WITHOUT HOOD.

23. Use of Anti-Gas Garments

Wherever there is any danger from vapour the respirator must be worn, and if there is blister gas on the ground, rubber boots are required. Leather gives only a short period of protection, and is very difficult to decontaminate.

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

Owing to the exhaustion caused by the heavy anti-gas suits they 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 lesser forms of protection may be adequate and will cause much less reduction in efficiency. The apron should, for instance, be adequate for first aid personnel engaged merely in handling casualties who may be contaminated.

There are two methods of wearing the hood, jacket and trousers of the heavy suit, viz.:—

(*a*) Skirt of hood under the jacket, jacket inside the trousers and trousers inside the boots with a fold over the top of them; and

(*b*) Skirt of hood outside the collar of the jacket, jacket outside the trousers gathered in by a belt and secured in an air-tight fashion, and trousers outside the boots.

Protection against vapour is better in method (*a*) and this method should be used when there is no danger of liquid mustard gas entering the suit. When there is danger of liquid mustard gas running or being washed down the neck and/or inside the trousers or boots, method (*b*) should be used.

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.

Before putting on the compete anti-gas suit, it will be necessary to remove the ordinary clothing and

change into other underclothing. The wearing of anti-gas clothing will impose limits on the possible period of work. If work has to be carried on in a confined space with heavy vapour contamination present, necessitating the wearing of the complete outfit with hood, it is probable that only three spells of from half an hour to an hour could be performed during each 24 hours. This depends on the temperature. In cold weather, or in less severe concentrations which do not necessitate the wearing of the hood, men might be able to work for three spells of two hours.

The protection against blister gas vapour afforded by the heavy anti-gas 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 blister gas vapour.

24. Order of Dressing and Undressing

The order of dressing in full anti-gas 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.

(6) Put on jacket.

(7) Adjust respirator in Alert position.

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

(9) Put on 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 anti-gas 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 helmet.
(2) Gloves.
(3) Respirator.
(4) Jacket or apron.
(5) Trousers lowered.
(6) Boots removed.
(7) Trousers removed.

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

(8) 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 different bins will be required for the following:—

(1) Boots.
(2) Anti-gas clothing.
(3) Respirators.
(4) Underclothing.
(5) Headgear, other than hoods.

CHAPTER VII

ANTI-GAS TREATMENT OF PERSONS

25. 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 the practice to reserve the words " decontaminate " and " decontamination " for the removal of contamination from material objects, and to describe the removal of bodily contamination of persons as anti-gas treatment, or to use 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, which should be flushed off with water within two minutes.

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, *or while liquid contamination is still visible on the skin,* the individual should be undressed and washed with hot water and soap as soon as practicable, and redressed in clean clothing. *The bleach mixtures are only more efficacious than washing when they can be applied within five minutes of contamination.*

The bleach in either form will rapidly destroy mustard gas, but it will also irritate the skin if left in contact with it. Care must be taken to avoid bleach getting into the eye.

The washing can be done anywhere that hot water is available, and the sooner it is done the better. A First Aid Post is one possible place, and if it is known that serious liquid contamination has been sustained,

it would in any case be best for the patient to go to a First Aid Post, after the first washing, for further advice and treatment.

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 27.

The mere process of washing and changing clothing can and should be undertaken by the public in their own homes or places of work if it can be managed sufficiently promptly. Recourse should only be had to a First Aid Post if no quicker means of washing are available, or if the contamination has been severe, and first aid treatment may be required.

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.

26. 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.

There should therefore be a cleansing place available for all members of air raid precautions services when they come off duty. Where convenient this should be at the station or depot on which they are based; but alternatively a central cleansing depot may be provided for groups of men stationed at neighbouring depots.

The requirements of a cleansing depot are explained in Appendix H. The routine should be that when the men come on duty they should take off their own clothing (including under-clothing) and put on other clothing provided for the purpose; and when coming off duty should discard their duty clothing (or, if it is contaminated, have it taken off by undressers), and wash themselves before putting on their own clothes once more. (This change of underclothing will be necessary whenever they have to wear oilskin anti-gas clothing, whether they encounter gas or not.)

Where a central cleansing depot is in use, the men should go to that place on first commencing their tour of duty, and put on their working clothes. Their own clothes would then be waiting for them when they finally returned to the cleansing station after work.

Undressers (themselves wearing some form of anti-gas 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 Chapter, unless it is decided that it is more convenient to decontaminate it on the spot.

CHAPTER VIII

DECONTAMINATION OF CLOTHING AND EQUIPMENT

27. Decontamination of Clothing

It is of the greatest importance that clothing which has been contaminated with a blister gas should be properly decontaminated before it is again worn. Where the contamination has been by vapour only, this is not difficult and the processes described below can be reliably carried out in the home or elsewhere. Where, however, the contamination has been by liquid, it is inadvisable for the decontamination to be undertaken elsewhere than in properly equipped premises, except perhaps in the case of the simpler articles. The handling of articles contaminated with liquid blister gas during the process of decontamination is itself a matter requiring care and precautions, and should only be undertaken by personnel equipped with suitable protective clothing.

Five methods of decontaminating clothing are available in principle. It is not necessary to describe here in detail the methods of using and controlling the special plant referred to.

(1) *Boiling in water*

In this process the blister gas is destroyed (decomposed) by the boiling water. The work must be carried out in a well-ventilated place to prevent the accumulation of a dangerous concentration of vapour. Sea water may be used.

(2) *By steam treatment in a high pressure steam disinfector*

This process operates partially by the evaporation of the blister gas by heat and vacuum treatment, followed by destruction of the remainder by means of pressure steam. It can be carried out only by the use of special

plant. and in this case the vapour extracted must be led away to a place where it will do no harm.

The process involves the admission of steam at pressures up to 15 lbs. per square inch alternating with extraction of the vapour by vacuum. The total process for each batch of garments would last an hour.

Wet garments must first be dried before being subjected to this process, otherwise rotting may be caused. The drying process may be carried out either by weathering (see below) or by hot air treatment in drying rooms. In the latter case the vapour escaping from the room is dangerous.

(3) *Baking in hot, dry air*

This process operates by the evaporation of the blister gas. Again a special plant is required, and the vapour extracted must be led to a place of safety.

Careful control of temperature is required during this process.

(4) *Washing with soap and water*

In this process the blister gas is removed mechanically from the article to the water. This method is only suitable for cases of vapour contamination.

(5) *Weathering*

This process consists simply of exposure to the open air for a suitable period, until the blister gas has evaporated, or until the article is dry enough to be be treated by steam (see above). If the article has been heavily contaminated, there may be some danger from vapour in its immediate proximity.

The choice of method to be adopted will depend upon the degree of contamination and the nature of the article contaminated.

Vapour Contamination only

The methods given under this heading should be used only where it is *known* that the garments have not been exposed to liquid contamination. If there is even a *possibility* of liquid contamination the methods of treatment given under the next heading should be adopted.

Outer garments of all sorts: boots and equipment.	Hang in the open air for at least 24 hours. If any garment or article still smells of gas after 24 hours, treat as for liquid contamination.
Light dresses and underclothing.	Wash with soap and water for at least 15 minutes and rinse well.

Liquid Contamination

Woollen garments (including suitings and underwear), silk and wool mixtures and good quality artificial silk garments.	Boil in plain water for one hour, keeping the garments fully immersed. If the boiling process is carried out with laundry machinery the time of boiling can safely be reduced to less than one hour. If the garments are greasy, the time of boiling should be doubled. Alternatively use the high pressure steam treatment *if the garments are dry*.

Woollen garments, as well as silk and artificial silk, may be boiled provided that plain water alone is used, without the addition of any soap or alkalis, and that the garments are not stirred while boiling, though they may be gently prodded down, or turned over, with a stick.

Contrary to general belief, with these precautions woollen garments will not suffer serious shrinkage in the boiling process, unless they are of shoddy material in which the wool has not been shrunk, or has been stretched, before weaving. It is not improbable however that certain dyes may run, and the garment may have a blotched appearance afterwards.

All cotton and linen fabrics.	Boil for half an hour in water to which two ounces (one handful) of washing soda per gallon has been added. Keep the garments fully immersed.
Heavier canvas fabrics.	Do. for one hour.

The presence of the soda will prevent deterioration of the fabric. It will however probably be impossible to prevent fading and running of the colours.

Oilskin, including anti-gas clothing.	Boil for half an hour in plain water. Keep the articles fully immersed.
Gumboots.	Do. for two hours.
Boots and other leather articles which would be injured by boiling water or steam.	Bake in hot dry air under carefully controlled conditions.

28. Decontamination of Respirators

The decontamination of respirators will depend on whether they have sustained vapour contamination only, or whether they have been splashed with liquid gas. In the latter event the respirator must be withdrawn at once, and replaced.

Vapour contamination

The occasions on which the general public would be likely to require to use their respirators (e.g., for

passing quickly through gas vapour in the street, or escaping from a damaged refuge) are most unlikely to result in the respirator becoming contaminated in any degree requiring decontamination. It will probably be impossible to detect any smell of vapour on the respirator. No treatment should therefore normally be necessary, though cases of prolonged vapour contamination may occur. As a precaution, however, Civilian respirators which have been used in blister gas should be hung, out of their cartons, for a period as opportunity offers. If they can be hung out of doors, but protected from rain, so much the better. Their owners must not, however, let themselves be parted from them.

Those provided with Civilian Duty or Service respirators, on the other hand, are likely *ipso facto* to have had to remain in gas in the course of their duty. If the gas was blister gas, both respirator and haversack should be hung separately in the open air, but protected from rain, until they are required for the next spell of work. Where possible, this airing should last for 24 hours. Meanwhile their owners can rely on their Civilian respirators in so far as there are no spare Civilian Duty or Service respirators available.

Respirators which still smell of blister gas after 24 hours' airing should be treated as for liquid contamination.

Liquid contamination

As the facepiece of the Civilian respirator, with its fixed transparent window, cannot be decontaminated by boiling, these respirators cannot be made serviceable after *liquid* contamination, and the facepieces must be destroyed. The containers should be detached and treated on the outside with a paste of bleaching powder and petroleum jelly, such as vaseline, for ten minutes, and then wiped clean.

The facepieces of Civilian Duty and Service respirators are fitted with removable eyepieces. If the respirator has sustained liquid contamination, the eyepieces and the container should be removed and treated

with a paste of bleaching powder and petroleum jelly for ten minutes (this should be applied to the outside of the container only), and then wiped clean. The facepieces and other rubber parts (including the connecting tube of Service respirators) should be immersed in boiling water and kept boiling for three hours.

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

29. 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 boiling as laid down for protective clothing in Section 27.

Should the stretcher become contaminated in spite of this precaution, the canvas will have to be removed from the handles and immersed for one hour in boiling water to which soda has been added. 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, for 24 hours if possible.

§ 13] APPENDIX A

THE FITTING AND USE OF THE CIVILIAN RESPIRATOR

A.—Fitting

The facepiece of the Civilian respirator readily adapts itself to the shape of the wearer's face and it is held in position by three easily adjustable straps. Fitting is therefore a simple matter of selecting the proper size of respirator and adjusting the straps to suit the wearer's head.

The respirator is made in three sizes, large, medium and small. The LARGE size is correct for most men's faces, and the MEDIUM size for most women's faces; the SMALL size is intended for children. The size is marked on one of the head straps.

The fitting can be carried out if necessary by the wearer himself, but it can be done more conveniently and quickly by a second person.

When fitting the respirator, a man should first try a Large size; a woman, youth or girl a Medium size; and a child a Small size. The respirator is to be put on as described below. Spectacles, if worn, must first be removed.

To put on the respirator

Hold the respirator by each of the side straps with the thumbs underneath the straps, so that the inside of the window is facing you. The respirator will thus hang from the straps in the proper position for putting on the face. Lift the respirator to the face, thrust the chin forwards into it and draw the straps over the top of the head as far as they will go. Let go of the straps and make any small adjustments which may be necessary, e.g., the edge of the rubber may be turned inwards under the chin, one of the straps may be twisted, or the facepiece may not be straight on the face.

Strap adjustment

When the respirator has been put on, make sure that the buckle is at the back of the head just below the crown so that the two side straps are roughly level. Then adjust the straps, keeping the buckle in the same correct position, so that the facepiece is in contact with the skin all round the face. In doing this, *particular attention should be paid to lifting the facepiece well up on the face so that it makes good contact under the chin.* The straps must not be made any tighter than is required to keep the respirator in place when the head is nodded or shaken.

Size

Next see that the size is right for the wearer. If the size is right and the straps are adjusted properly, the wearer's eyes will appear practically in the middle of the window and the eyebrows will be visible below the top of the window.

If the eyes are much above the middle of the window and the eyebrows cannot be seen, make certain that the respirator is properly lifted on to the face. If it is as high as it will comfortably go, a bigger size of the respirator is desirable. If a large size is already being worn it means that the wearer's face is of unusual length, but the respirator will still give complete protection.

If the eyes are much below the middle of the window and the facepiece clearly goes on to the face too far a smaller size is desirable.

It does not follow that a person will not be protected if a respirator is worn which is slightly too large or too small, but attention must be paid to providing the proper size for the wearer so as to make sure that there is as little discomfort as possible.

When the respirator is worn, the air breathed out passes out of the respirator between the edges of the rubber facepiece and the wearer's face. It is clear

therefore that the more tightly the facepiece is fitted on to the face the more pressure will have to be exerted by the wearer in breathing out. This must be borne in mind when choosing the size for the wearer and in adjusting the straps. If the respirator is too small or if the straps are adjusted too tightly the effort of breathing out will be increased.

To test fitting.

If the respirator has been properly put on and properly fitted the only source from which air can be drawn by the wearer is through the container. This should be verified by stopping up temporarily the perforated end of the container in some convenient manner (e.g. by holding a piece of smooth cardboard or rubber firmly against it) while the wearer attempts to breathe in strongly. The facepiece should be sucked in against the face by this process and there should be no leakage around the edge of the facepiece.

When this test shows that fitting and putting on have been correctly done, draw a pencil line across each of the straps along the edge of the buckle to mark their adjustment.

The respirator is then to be removed in the following manner:—

To remove the respirator

Insert a thumb under the buckle at the back of the head and pull the buckle forwards over the top of the head so that the respirator is lowered downwards from the face (*see* Fig. 17).

The respirator must not be removed by grasping the container (or the edge of the rubber under the chin) and lifting it off upwards. The only method which is to be used is that described above.

Securing the adjustment

After fitting and removal of the respirator, the strap adjustment is to be made secure by pinning the ends

of the straps to the portions between the buckle and the facepiece. The pencil marks must be in the same position after pinning as they were when the respirator was fitted.

B.—Use

Before any occasion arises to use the respirator, it should have been properly fitted, and the adjustment of the straps secured with safety pins, as described above.

The respirator must always be carried by its owner in time of war wherever he may be by day or night. He should pay constant attention to keeping it and carrying it so as to avoid damage (see Section 14).

Immediately gas is encountered, or the alarm "GAS" received, the respirator is to be put on as quickly as possible. This should be learned as a drill, as follows:—

(i) Hold the breath and throw off any head-gear (or hold it between the knees). Remove spectacles.

(ii) Pick up the respirator, and hold it in front of the face by each of the side straps with the thumbs underneath the straps (*see* Fig. 14).

(iii) Thrust the chin forwards into the respirator and draw the straps over the head as far as they will go (*see* Fig. 15).

(iv) Breathe out, and continue breathing in a normal manner.

(v) Adjust the respirator squarely and comfortably on the face (*see* Fig. 16), and run the fingers over the facepiece to make sure that edges are not doubled inwards or the straps twisted. The buckles should rest on the back of the head. Replace head-gear, and pick up the carton of the respirator.

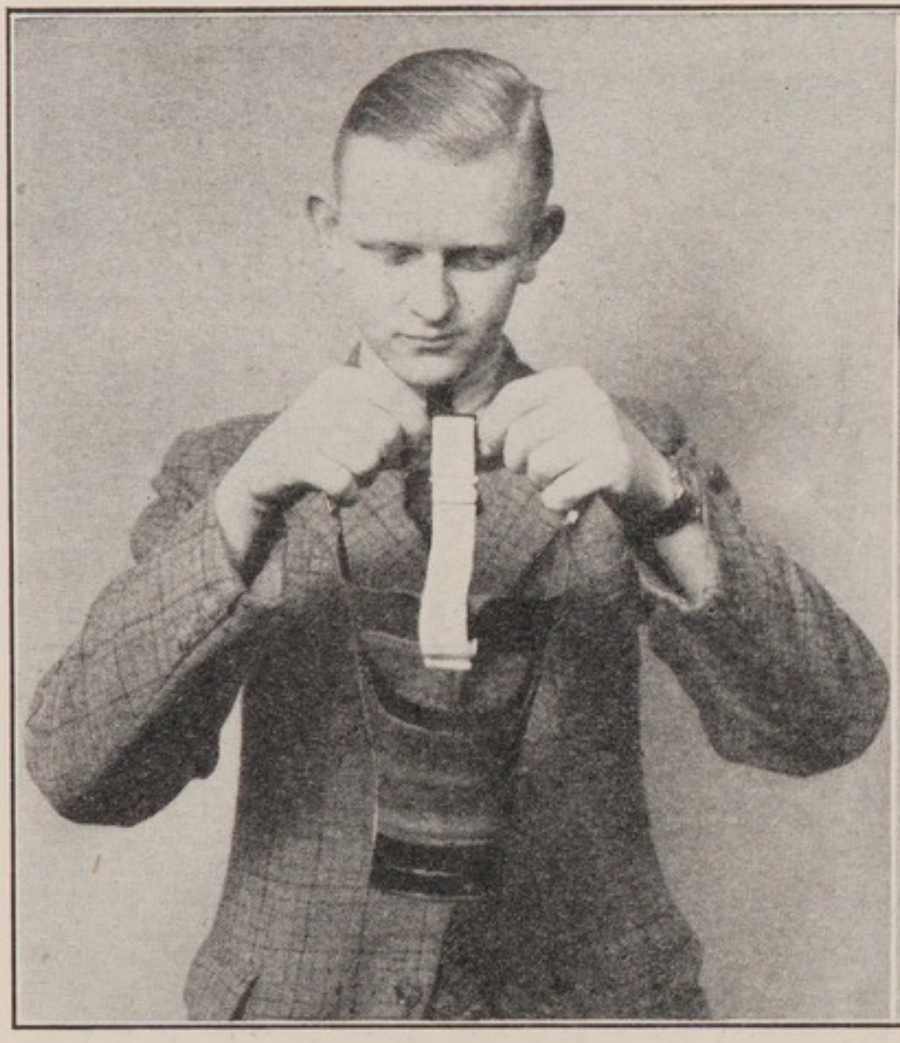


FIG. 14—STARTING TO PUT ON THE CIVILIAN RESPIRATOR.

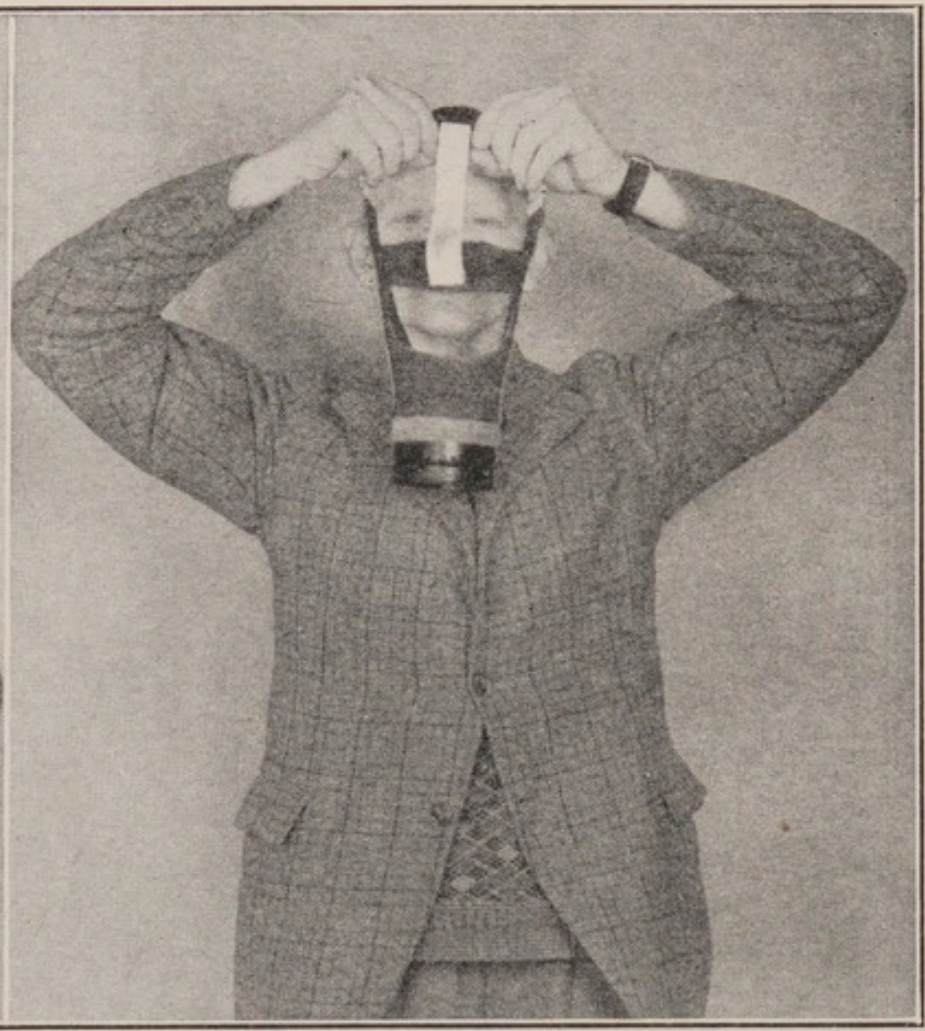


FIG. 15—THRUSTING THE CHIN INTO THE CIVILIAN RESPIRATOR.

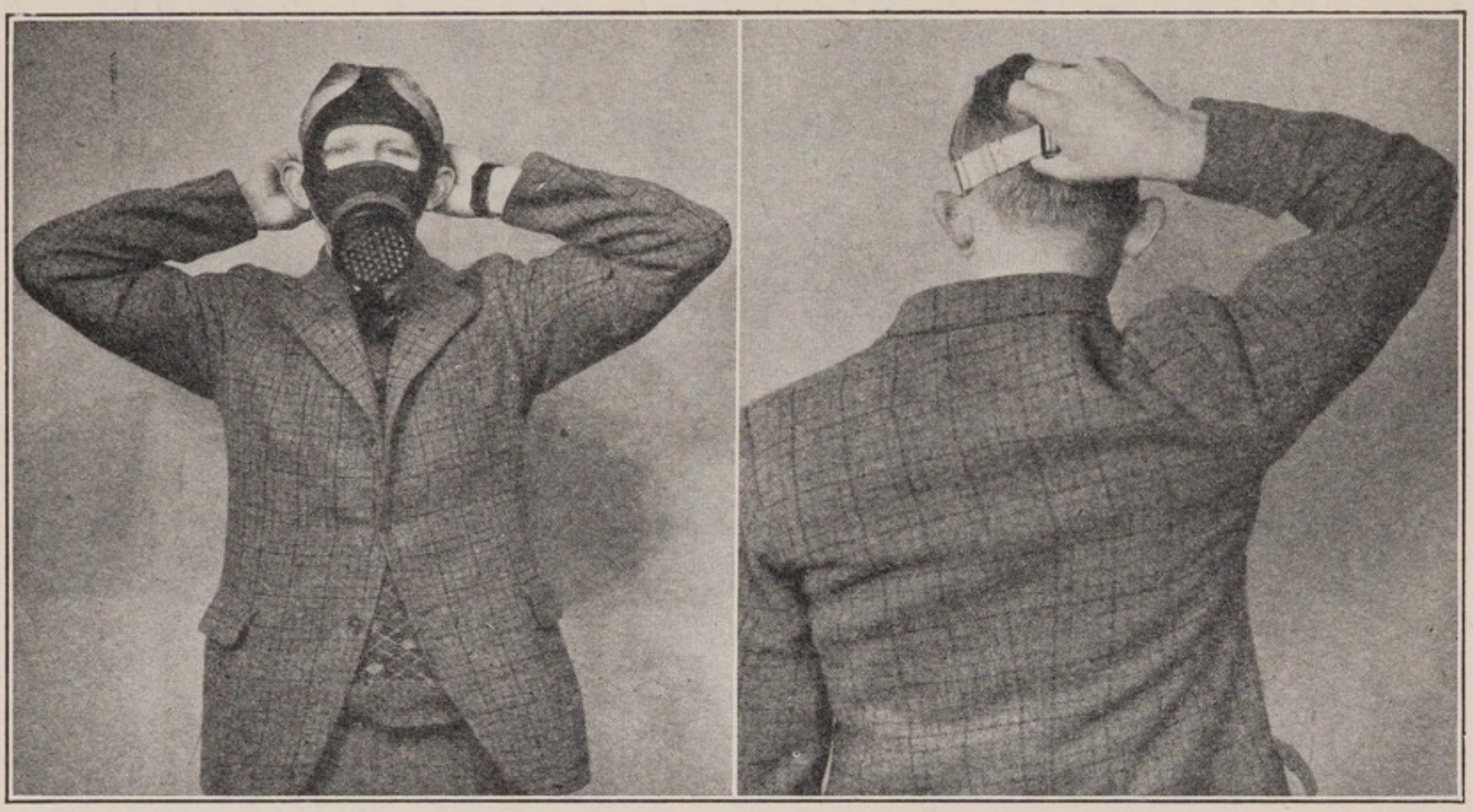


FIG. 16—ADJUSTING THE CIVILIAN RESPIRATOR.

FIG. 17—STARTING TO REMOVE THE CIVILIAN RESPIRATOR.

(vi) *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 one 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 that might have leaked in during the test.

When taking off the respirator, be very careful to do it as described in A above, by drawing the headharness forward off the head. See Figure 17. *Never take it off the chin first.*

To Adjust a Civilian Respirator on another Person.

The following instructions are given for adjusting a respirator on another person who cannot do it for himself (a child, for instance, or someone who is injured). The procedure can be carried out on anyone who is sitting or lying, or on a small child who is standing—i.e. whose head is low enough to be below the shoulder-level of the person who is adjusting the respirator. It cannot normally be used on an adult 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) Fold back the headharness outside the facepiece. Grip the facepiece with both hands on either side of the chin-hollow, thumbs inward.

(ii) Stand behind the other person and draw the chin-hollow over his chin. As soon as it is in position slide the hands up the edge of the facepiece, catching the headharness on the way, and draw it over the head into position.

(iii) Adjust the tension of the headharness, and the edges of the facepiece.

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 the sizes 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. If the respirator is fitted with a Mark III container, the perforated end should be closed by holding a piece of smooth cardboard or rubber firmly against it. Instruct the wearer to attempt to breathe in and to say if the 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 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.

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.—Use

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. 18 A):—

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. 18 B):—

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. 19).

A—Normal Position. B—Alert Position.

Fig. 18—C.D. Respirator being carried

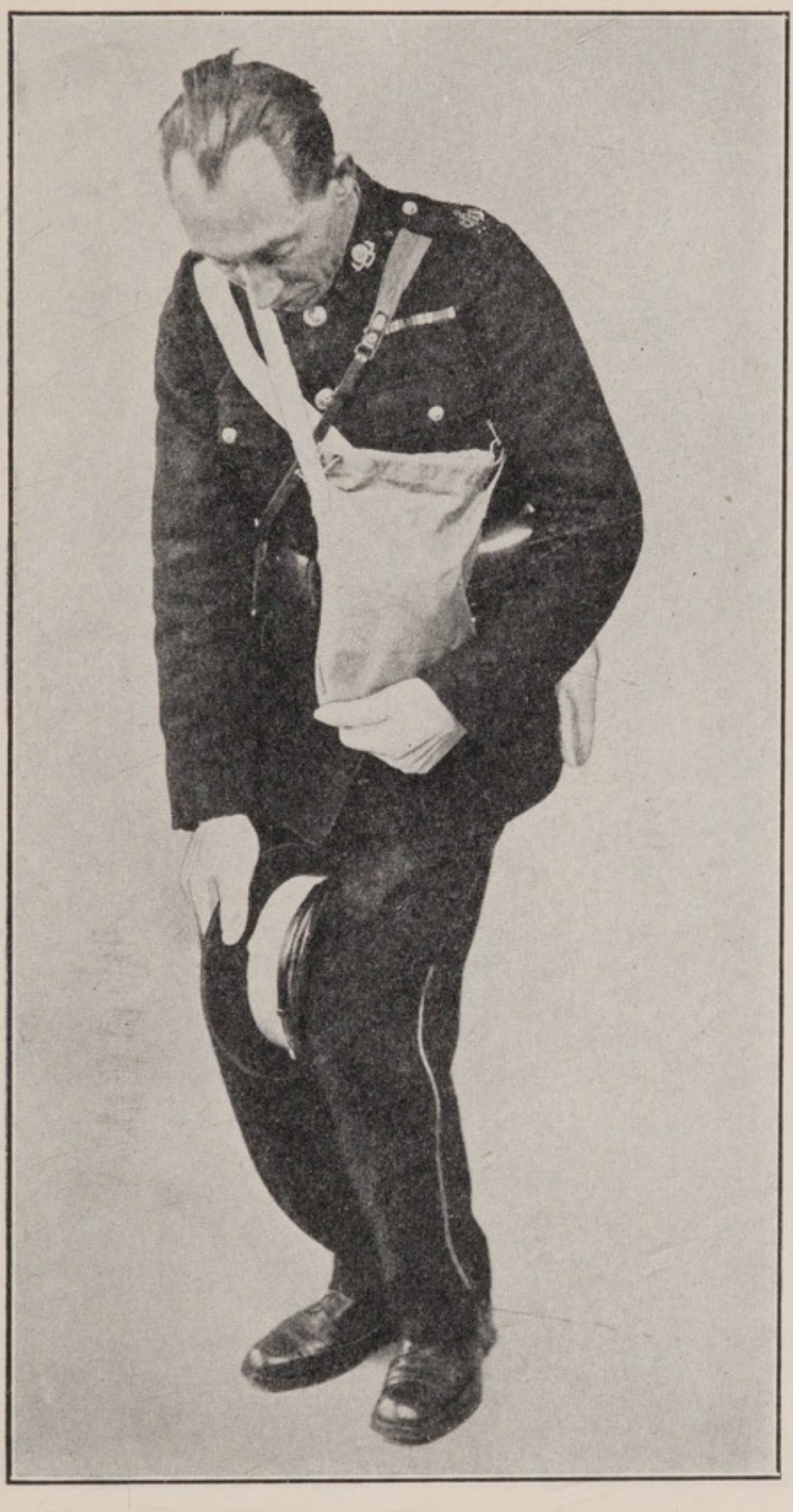


FIG. 19—CIVILIAN DUTY RESPIRATOR—ACTION ON ALARM "GAS", STAGE ONE.

FIG. 20—CIVILIAN DUTY RESPIRATOR—ACTION ON ALARM "GAS", STAGE TWO.

(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. 20).

(iv) Insert the left thumb under the centre of the headharness at the point where the two lower elastic bands are attached, and allow the respirator to hang. Insert the right thumb beside the left and then slide the thumbs wide apart along the two adjacent elastic bands on each side (*see* Fig. 21).

(v) Bring the respirator towards the face. Dig the chin into it, and draw the respirator on to the face by passing the headharness smartly over the head with the thumbs.

(vi) Breathe out and continue breathing in a normal 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. 22).

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.

FIG. 21—CIVILIAN DUTY RESPIRATOR—ACTION ON ALARM "GAS", STAGE THREE.

FIG. 22—CIVILIAN DUTY RESPIRATOR FULLY ADJUSTED AFTER ALARM "GAS".

IMPORTANT.

When removing the respirator from its haversack, it should never be withdrawn by pulling on the container alone. 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, 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 following instructions are given for adjusting a Civilian Duty respirator on another person who cannot do it for himself (if, for instance, he is 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) 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.

(ii) 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.

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

§ 17] APPENDIX C

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 the sizes 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.—Use.

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 facepiece 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) Bring the facepiece towards the face. Dig the chin into it, and draw it 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 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. Remove headgear and place between the knees.

(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 (iii) 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 facepiece 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 facepiece 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 it 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 facepiece 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 facepiece in the haversack, forehead portion first, harness buckles to the wearer's right. Fold over the haversack flap between the haversack and the body.

To Adjust a Service Respirator on another Person.

The instructions given at the end of Appendix B for adjusting a Civilian Duty respirator on another person will apply also to the Service respirator, except that the placing of the haversack presents a further difficulty. This may be met by the following procedure:—

> Bring his haversack to the front of his chest, with the sling in the usual Alert position, but do not waste time, at this stage, in tying the whip-cord. Take the facepiece out of the haversack, and hold it with the outlet valve towards you.

After this, the procedure will be as described in Appendix B, the last step being to make secure the adjustment of the sling of the haversack.

§ 14] APPENDIX D

DISINFECTION OF CIVILIAN RESPIRATORS

Whenever it changes ownership, or in the event of an outbreak of infections disease, the respirator will be disinfected in the following manner:—

(1) Remove the rubber band, disconnect the container from the facepiece and remove the rubber disc valve from the container.

(2) Immerse the entire facepiece, the valve and the rubber band in a 2 per cent. solution of Formalin* for 30 minutes. Then remove them from the disinfecting solution and wash under running water for 5 minutes, or in several changes of water if running water is not available. Then hang up the facepiece, valve and band to dry.

(3) Hold the container by the rim on the outer end and sponge over the inner end and rim and the entire surface of the cylindrical body with cotton wool or a soft cloth which has been immersed in a 2 per cent. solution of Formalin and freed from excessive liquid. Allow to stand for 5 minutes and then wipe off the disinfecting solution with a soft cloth or sponge which has been wrung out in clean water. Then allow the container to dry. Care must be taken not to allow any liquid to enter the container during these operations.

(4) When all the parts of the respirator are dry they are ready for reassembly.

The respirator is to be reassembled in the following manner:—

(i) Replace the rubber disc valve on the stud in the container end.

---

* NOTE.—The disinfectants approved for use with the Civilian Duty and Service respirators may not be used with the Civilian respirator.

(ii) Grasp the container by the rim on its outer end and insert one side of the inner end into the aperture in the facepiece at a point immediately under the window. If the facepiece is a Large size, the edge of the rubber should be brought just over the raised swage in the container body, and if it is either a Medium or Small size the edge of the rubber should be brought just up to the raised swage. Hold the rubber in place on the container with the fingers, insert the fingers of the other hand inside the facepiece and stretch the rubber outwards and slip it over the container.

If the facepiece has not been slipped over the container far enough it must *not* be corrected by pulling the edge of the rubber; the fingers are to be inserted in the facepiece and the rubber lifted and *pushed* on to the container. See that the edge of the rubber is not turned in, that it is straight round the container, and in the correct position according to the size of the facepiece.

(iii) Place the rubber band in position around the container so that one half of its width lies on the rubber of the facepiece and the other half on the container.

§ 18] APPENDIX E

DISINFECTION OF CIVILIAN DUTY RESPIRATORS

The stores required for disinfection of each respirator are:—

An approved disinfectant (see Appendix G).

Cloths, disinfecting, facepiece—2.

Pads, disinfecting—1 (for Mark I or II containers only).

A.—Normal Procedure

A solution of approved disinfectant will be prepared in the dilution specified in Appendix G. The solution should be freshly prepared for use on each occasion, and not more than 100 facepieces should be disinfected with three gallons of the solution.

Turn the facepiece completely inside out and sponge out the entire inner surface of the facepiece, including the eyepieces, and the top of Mark III containers (but not Mark I or II), with the disinfecting solution.

Turn the facepiece back to its normal shape and pour a little of the solution into the depression between the eyepieces. Then, pinching the outlet valve between the fingers, carefully tilt the mask so that the disinfecting liquid flows into the valve. When the valve is filled, release it and allow the liquid to drain away through the valve. Any solution remaining in the mask should be emptied out, care being taken not to wet the gauze pad on the Mark I or II container more than necessary.

Set the mask aside and proceed as above with other masks, arranging the routine so that each facepiece stands with a film of the disinfecting solution on it for at least five minutes.

After the facepiece has stood for five minutes, repeat the procedure above with clean water instead of the solution and sponge out the whole of the inside surface of the facepiece and the top of the Mark III container (but not Mark I or II) with water.

Wipe the inside of the facepiece with a clean cloth, disinfecting, and set it aside to dry off thoroughly at room temperature. Remove and throw away the disinfecting pad of the Mark I or II containers.

In the case of Mark I and II containers, before putting them away, the perforated top is to be wiped over with a cloth wrung out in the solution, allowed to stand for at least five minutes and then wiped over with a cloth wrung out in water. Care must be taken not to allow liquid to run into the perforations. Finally, a new pad, disinfecting, is to be fitted and secured in place with the spring.

B.—Procedure in the event of an Epidemic or Occurrence of Infectious Disease

In the event of an epidemic, the procedure described in A, above, will be immediately discontinued, and respirators will be disinfected according to the following procedure:—

A solution of approved disinfectant will be prepared, in the dilution specified in Appendix G. The solution should be freshly made for use on each occasion, and not more than 50 facepieces should be disinfected with three gallons of the solution.

The container will be detached by removing the turns of binding wire or cord. The wire or cord is to be destroyed. The container will then be removed by gently withdrawing it from the aperture of the facepiece with a slight turning movement.

In the case of Mark I and II containers, the pad, disinfecting, will be removed and destroyed.

The eyepieces and eyepiece rims are to be removed.

The whole of the facepiece, the eyepieces, the eyepiece rims and (in the case of Mark I and II containers) the spring retaining the pad, disinfecting, are then to be completely immersed in the disinfecting solution. Any convenient vessel may be used to accommodate a number of facepieces at one time.

After five minutes the facepiece, eyepieces, eyepiece rims and spring are to be removed from the disinfecting solution and thoroughly washed with water.

As much water as possible will be shaken off the facepiece. The whole facepiece, and the eyepieces, eyepiece rims and spring will then be laid out to dry. The facepiece must be quite dry before re-attaching the container.

The container is to be wiped over with a cloth wrung out in disinfecting solution, allowed to stand for five minutes, and then wiped over with a cloth wrung out in water. Care must be taken not to allow liquid to run into the perforations.

After disinfection, and when dry, the eyepieces will be re-assembled and the container must be re-attached as follows:—

The top end of the container is to be inserted in the central aperture of the facepiece and gently pressed inwards with a slight turning movement until the metal rim of the container is in contact with the flange at the base of the cylindrical aperture in the facepiece. The container is secured by binding with wire on to the outside of the rubber below the flange.

In the case of Mark I and II containers, a new pad, disinfecting, is then to be fitted and secured in place with the spring.

APPENDIX F [§ 18

DISINFECTION OF SERVICE RESPIRATORS

All these respirators will be disinfected twice yearly and on every occasion that the facepiece changes ownership.

The stores required for disinfection of each respirator are:—

An approved disinfectant (see Appendix G).
Cloths, disinfecting, facepiece—2.

A.—Normal Procedure

The procedure for disinfection, which will be carried out in two operations, is as follows:—

A solution of the approved disinfectant, in the dilution specified in Appendix G, will be prepared. The solution should be freshly prepared for use on each occasion, and not more than 100 facepieces should be disinfected with three gallons of the solution.

Sponge out the entire inner surface of the facepiece (including the eyepieces) with the disinfecting solution, taking care not to allow the liquid to enter the air inlet orifices which are at the sides of the eyepieces in Facepiece Mk. III and between the eyepieces in Facepiece Mk. IV.

Turn the facepiece completely inside out, so that a cup-shaped depression is formed over the outlet valve.

(*a*) For Facepiece Mk. III.—Nip the outlet valve between the fingers and pour into the cup-shaped depression about two fluid ounces of the disinfecting solution.

Swill the solution round gently, then release the outlet valve and allow as much of the solution as possible to drain out through the valve. Any solution remaining in the mask should be emptied out.

(*b*) For Facepiece Mk. IV.—Close the air inlet orifice between the eyepieces by inserting the thumb carefully in the hole. Pour about two fluid ounces of the disinfecting solution into the cup-shaped depression over the expiratory valve and swill round. If the solution does not pass out through the valve, tilt the facepiece over and allow the liquid to escape.

Set the facepiece aside and proceed as above with other facepieces, arranging the routine so that each facepiece stands with a film of the disinfecting solution on it for at least five minutes.

After the facepiece has stood for five minutes, repeat the procedure at (*a*) or (*b*) with clean water instead of the solution, and sponge out the whole of the inside surface of the facepiece with water.

Wipe the inside of the facepiece with a clean cloth, disinfecting, and set it aside to dry off thoroughly at room temperature.

Care must be taken as far as possible to avoid wetting the stockinet covering of the mask, as this requires a long time to dry.

In no circumstances must water or disinfecting solution be allowed to enter the air inlet orifice in the facepiece.

B.—Procedure in the event of an epidemic or occurrence of infectious disease

In the event of an epidemic, the procedure described in A, above, will be immediately discontinued, and facepieces will be disinfected by the following procedure.

A solution of the approved disinfectant, in the dilution specified in Appendix G, will be prepared. The solution should be freshly made for use on each occasion, and not more than 50 facepieces should be disinfected with three gallons of the solution.

The rubber connecting tube will be detached from the container, and the whole facepiece, with connecting tube, immersed in the disinfecting solution. Any convenient vessel may be used to accommodate a number of facepieces at one time.

After five minutes the facepiece is to be removed from the disinfecting solution and thoroughly washed out with water.

As much water as possible will be shaken off the facepiece and out of the connecting tube. The whole facepiece will then be laid out to dry. The time taken to dry will vary with the time of year, but it is essential that all moisture is allowed to dry out of the connecting tube before replacing on the container.

In addition, the inside of the neck of the container will be carefully wiped out with a rag moistened with the solution, the greatest care being taken to prevent any of the solution from penetrating to the chemicals in the container.

After disinfection, the rubber connecting tube should be re-attached to the container with wire binding.

§ 18] APPENDIX G

DISINFECTANTS FOR CIVILIAN DUTY AND SERVICE RESPIRATORS

The following is a list of disinfectants which have been tested and approved for use in the cleansing and disinfection of Civilian Duty and Service respirators:—

Disinfectant.	*Concentration to be used for* (a) *Cleansing.*	(b) *Disinfection*
Goodhalls P.H. ...	⅓% solution	2% solution.
Monsanto White Disinfectant Fluid No. 1.	do.	do.
Izal	½% solution	3% solution.
Jeyes' White Cyllin	do.	do.
Kilcrobe W.O. Disinfectant Fluid.	do.	do.
Kolium W.O. Disinfectant Fluid.	do.	do.
Lawes' L.W. 4 White Oil Fluid.	do.	do.
McDougall's Municipal Disinfectant Fluid.	do.	do.
W.O. Disinfectant Fluid "Arnfield."	do.	do.
White Bactocene Disinfectant Fluid.	do.	do.
White Killgerm ...	do.	do.
White Septol Disinfectant Fluid.	do.	do.
Acrosone	⅔% solution	4% solution.

As a ready means of measuring small percentages, 1½ eggcupsful to 3 gallons may be taken as equivalent to ⅓ per cent. and 2 eggcupsful as ½ per cent.

NOTE.—None of these disinfectants may be used with the Civilian respirator.

APPENDIX H [§ 26

Cleansing 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.

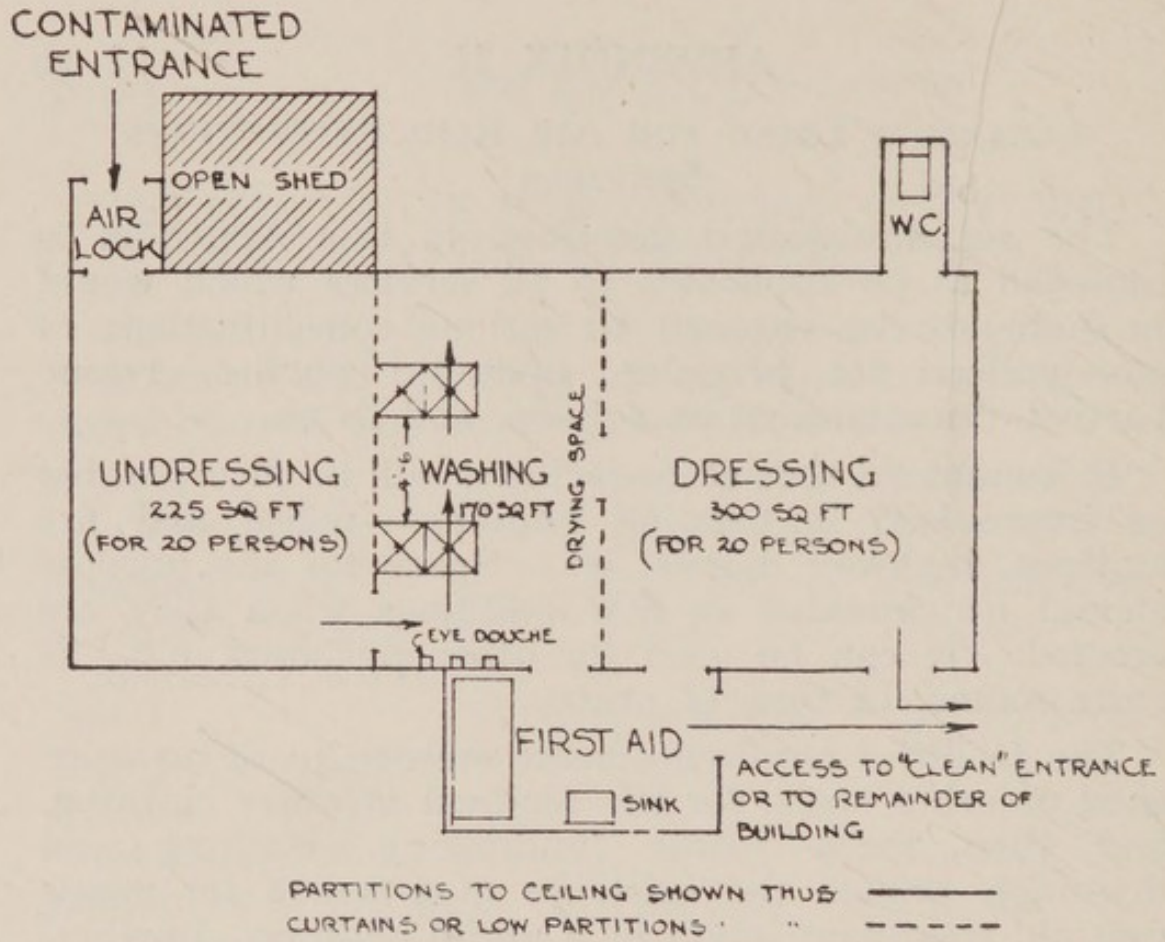
It is assumed that these facilities will be incorporated or improvised in existing buildings—police and fire stations, highway depots, etc. Space for the purpose should be provided in new buildings when they are erected. It can be used for other purposes, e.g., as store rooms, in time of peace.

The facilities required consist essentially of an open shed or other space for the removal of outer clothing, and then three rooms (undressing, washing and dressing), though the existence of a fourth for minor first aid treatment might be a useful addition. Further, there must be space for storing clean clothing and clean towels. Where the staffs include both sexes, two cleansing stations will be required.

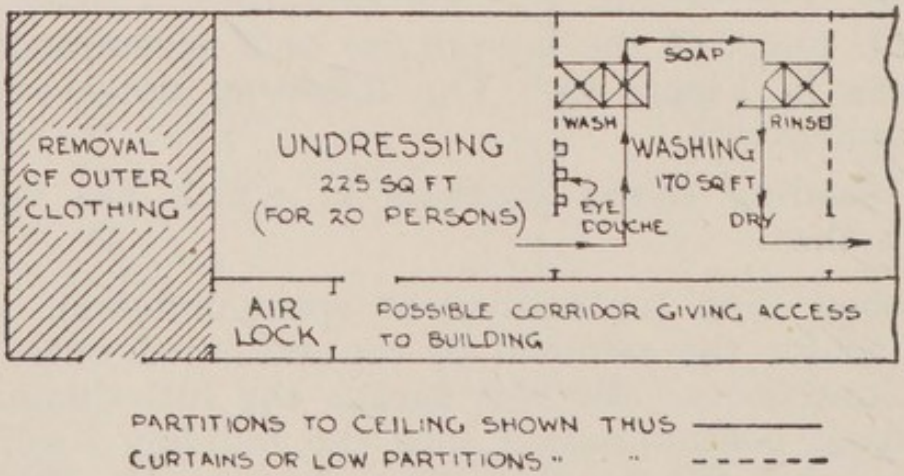
Sketch plans of the lay-out for this accommodation are given in Figure 23. The following notes explain the requirements.

The shading shows portions in which gas vapour might collect.

External shed (or equivalent space indoors). This is needed for the removal of contaminated outer garments and boots. By this means the introduction of the grosser contamination into the building itself can be avoided. Where this space has to be provided within the building, the access to it should be unprotected by an air lock, and its windows should be kept open for constant ventilation. It should be treated as outside the gas-protected part of the building.



A—WITH OPEN SHED.



B—WITH ROOM IN PLACE OF OPEN SHED.

FIG. 23.—LAY-OUT OF CLEANSING DEPOT FOR A.R.P. SERVICES.

There should be an air-lock between it and the rest of the building.

This space should be equipped with forms to sit on, preferably covered with american cloth, and it should contain bins with close fitting lids for contaminated clothing.

Room 1 (*Undressing*) should be as near as possible to the access from the shed or other space used for the removal of outer garments, and should in either case be protected by an air lock. An air lock is not necessary between this room and Room 2.

The undressing room should also be equipped with forms covered with american cloth, and bins for contaminated clothing. It should also have a latrine bucket, since men who are contaminated must not be allowed to use w.c's. which are used by other persons.

The capacity of the room should be assessed on a basis of about 15 sq. ft. per person. The size of the room should be such that it will accommodate the whole batch of men or women who might be expected to need it at one time, on the assumption that they would occupy it for about 5 minutes.

The washing arrangements in Room 2 should preferably consist of showers, with warm water. Four showers should be sufficient for a batch of 20 persons using the station at one time, 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 to wash out the eyes freely 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 wherever 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. In this room too about 15 sq. ft. should be allowed per person.

The cleansing station should be provided with its own staff, which should include, according to its size, two or more undressers (who must themselves wear respirators and protective clothing) and one attendant, or more, trained in giving bleach and eye treatment and minor first aid. The precise arrangements will vary with the service concerned.

The whole station (except a room provided in lieu of the open shed) should be gas-protected so that it could be used even if gas were present outside and should be as far as possible resistant to splinters and blast.

The contaminated entrance, past the open shed, should be reserved for this purpose, and should not be used for ordinary access into and out of the building for uncontaminated persons. There should be a bleach tray beside it in which each person entering should first wipe his boots. Rooms 1, 2 and 3 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.

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 anti-gas clothing	8
Washing and drying	7
Dressing	10

Notes on Design and Materials

The following notes apply to the undressing and washing rooms, and to any room used instead of an open shed.

The interior should be as simple in design as possible, all unnecessary fittings, mouldings, etc., being avoided so as to facilitate decontamination.

At least the lower portions of the rooms should be constructed of smooth surfaced non-absorbent materials which can be readily decontaminated. Adequate water supply, and drainage facilities should be provided whenever possible, to enable hosing down to be carried out.

Each room should be capable of being well-ventilated, so that it can be quickly cleared of any concentration of gas which might collect in it; but this problem (which should receive special attention in cases where it is proposed to arrange cleansing accommodation in the basement of the buiiding) must, of course, be considered in relation to the general gasproofing arrangements in the building.

The recommendations as to materials given below refer in particular to the use of materials in relation to contamination by mustard gas, but may be taken as being generally applicable to other types of blister gas such as lewisite.

Floors. Flooring materials should be non-absorbent to blister gas and be capable of decontamination by the normal methods.

Generally the most suitable type of flooring is concrete with a granolithic or cement finish, both of which are improved by periodical treatment with a hardener such as sodium silicate solution. Proprietary waterproofing compounds, either pigmented or otherwise, may be used but have little effect on the behaviour of concrete towards mustard gas or decontamination processes. Acid-resisting or other special cements may be used but possess no special merit. Surface treatments of a bituminous nature are unsuitable for and increase the difficulties of decontamination.

Quarry tiles also provide a satisfactory flooring material. The tiles should be set in cement mortar with a fine joint and should also be periodically treated with sodium silicate solution. Unglazed tiles are not satisfactory, as the mustard gas is retained by the crazed surface.

In existing buildings the most satisfactory covering for wooden floors is sheet lead. This should be at least of 4 lbs. lead with burnt joints and be carried up the walls to form a coved skirting. A less expensive covering is linoleum (laid with as few joints as possible), but this has a comparatively short life under repeated decontamination.

Bare wooden floors, preferably of hardwood, may be used, but these are not recommended as repeated decontamination has an injurious effect on the timber. No advantage is gained by impregnating wooden floors with wood preservatives or fire-resisting compounds, and the use of varnish stains renders the process of decontamination more difficult.

Rubber flooring should not be used, as this material absorbs mustard gas.

Jointless flooring of the magnesium oxychloride type is unsuitable, as it is attacked by the solutions used in decontamination. Floorings of an asphaltic or bituminous nature are also unsuitable, since they

absorb blister gas and are difficult to decontaminate. Such floorings should, therefore, be avoided in rooms where frequent decontamination might be necessary, but if in other situations an asphaltic flooring is desirable, a mixture containing the highest possible percentage of Trinidad Lake asphalt should be used.

Walls. As far as possible, walls, particularly the lower 6 ft., should be finished with smooth-surfaced impervious materials which can be washed and decontaminated.

The most satisfactory materials are glazed bricks or tiles which should be of the best quality in order to avoid crazing, and should be set in cement mortar with a fine joint.

Smooth Portland cement and sand forms a satisfactory finish and is improved by periodical treatment with sodium silicate solution. Plaster finishes of either lime plaster or gypsum (wall) plaster may also be used but must be similarly treated.

Corrugated galvanised sheets can be used, the sheets being fixed with the corrugations vertical, special care being taken with the joints.

Fair faced brickwork, where ordinary building bricks are used, is unsatisfactory.

Wall finishings of an asphaltic or bituminous nature should not be used as they absorb and retain mustard gas.

Wall linings and panelling of match-boarding, plywood, fibre board or asbestos cement sheeting are unsuitable unless all joints are covered and the whole finished with a varnished paper or a resistant paint coating to eliminate joints and porosity.

Mouldings and panelling should be avoided, and the angles between the walls and floor should be coved either with tiles or cement; wood skirting should be avoided.

Paintwork. Research is proceeding in connection with the development of a type of paint which will resist attack by blister gases and can be decontaminated without damage to the film. Ordinary paints are not satisfactory, and therefore the use of materials which require painting should be avoided as much as possible. Where woodwork, etc., has to be used, it should be painted with a hard-drying enamel paint, but it should be realised that under repeated contamination failure of the material must be anticipated.

Fittings. The number of fittings should be reduced to the minimum, and they should be of the simplest possible design with no unnecessary ornamentation. Essential fittings should where practicable be situated on the upper half of the walls so as to be out of the zone of heavier contamination. Doors should be of the flush type without moulding or panels, and metal windows should be provided.

Plastics of the phenol-formaldehyde or urea-formaldehyde type (e.g., Bakelite or Beatl or Scarab ware) are most suitable for fittings. The casein type of plastic is satisfactory but is water absorbent. Glazed porcelain is also satisfactory and metal pipes and fittings may be used but should be treated with a suitable paint to prevent corrosion by bleaching powder.

Oiled fabrics and american cloth may be used for covering wooden benches, etc., but they can only be decontaminated by means of boiling.

Hard ebonite materials are not recommended as they absorb mustard gas.

INDEX

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Official Publications on Air Raid Precautions

HANDBOOKS—

See list on page ii within.

MEMORANDA—

No. 1.—Organisation of Air Raid Casualties Services (*2nd edition*). 6*d*. (7*d*.)

No. 2.—Rescue Parties and Clearance of Débris (*2nd edition*). 2*d*. (2½*d*.)

No. 3.—Organisation of Decontamination Services (*2nd edition*). 2*d*. (2½*d*.)

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No. 7.—Personnel Requirements for Air Raid General and Fire Precautions Services, and the Police Service (*1st edition*). 2*d*. (2½*d*.)

No. 8.—The Air Raid Warning System (*1st edition*). 3*d*. (4*d*.)

No. 9.—Notes on Training and Exercises (*in preparation*).

There is also a pamphlet on the Protection of Foodstuffs against Poison Gas (*1st edition*). 2*d*. (2½*d*.)

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