



# ASBESTOS IN WORLD WAR II RESPIRATOR CANISTERS (U)

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SUMMARY

The majority of British Service and Civilian respirator canisters manufactured just before and during the early years of World War II contained a particulate filter consisting of carded wool and asbestos in the proportion of about 80% wool to 20% asbestos. In about 1940 the particulate filter was improved by substituting resin-impregnated wool for the asbestos-wool. Guidelines based upon canister design and markings, are presented to enable those canisters containing asbestos to be identified so that appropriate measures can be adopted for their safe retention or disposal.

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KEYWORDS

1. Asbestos
2. Asbestos-wool
3. Baby Helmet
4. Canister
5. Civilian Duty Respirator
6. Civilian Respirator with Valve
7. Container
8. General Civilian Respirator
9. General Service Respirator
10. Helmet Respirator
11. Hospital Respirator
12. Light Type Respirator
13. Particulate Filter
14. Resin Impregnated Wool
15. Respirator
16. Small Childs Respirator

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### 3. SOURCES OF INFORMATION

3.1 At the end of WWII the Ministry of Supply commissioned a series of monographs as a permanent record of research and development carried out during the war. Whilst many proposed titles were never written or never reached the publication stage, two on chemical defence are of particular relevance. The first deals with the development and manufacture of civilian respirators (1) and the second with particulate filters of respirator canisters (2). Two of the unpublished drafts are of considerable interest. One deals with the development of Service respirators (3) and the other with the development and manufacture of respirator charcoal (4).

3.2 The War Office also commissioned a history of WWII. One section of this history dealt with "Special Weapons and Types of Warfare". Volume one of this series by Wiseman was entitled "Gas Warfare" and was published in 1951 (5). This gives an authoritative account of the development of the canisters used in Service respirators. This one time secret text was declassified by D/OR13 (NBC) in 1984.

3.3 "The Official History of the Second World War, Civil Defence" (6) also contains many references to the development of the civilian respirator, but these deal mainly with the policy, supply and cost and they provide little technical information.

3.4 The production of antigas equipment was the subject of a draft report by Wheeler (7). In this report he gives a comprehensive account of the development of the Service respirator and the charcoal used in the canister. He mentions the civilian respirator but points out that this became the responsibility of the Home Office Air Raid Precautions Department Supply Division in about 1937.

3.5 The Home Office published a large number of Air Raid Precaution Handbooks and Memoranda; by far the most useful are "Precautions against Gas" which appeared in three editions (8, 9, 10), and "Care and Repair of Respirators" which appeared in many editions of which two are particularly helpful (11, 12).

### 4. THE GENERAL CIVILIAN RESPIRATOR (GC)

4.1 The General Civilian respirator (GC) is shown in Figure 1. Designs for it were made in 1934 and the final specification was sent to the Home Office in July 1936. It was based on the concept of providing protection for "flight" to the gas proof room which was regarded as the first line of defence against gas. It was not to cost more than 2/6d (12½p); it had to use

materials that were in good supply and it was considered essential to use a different part of industry for its manufacture than that usually engaged in respirator manufacture so as not to interfere with the rearmament programme for the Armed Services.

4.2 Trotman says, "for civilian purposes a merino wool filter impregnated with carbon black was used when civilian respirators were first manufactured in 1935. This was soon superseded by a merino wool-asbestos filter and this became standard for the whole production of GC respirators made before 1939" (1). According to O'Brien this was about 40 million respirators (6).

Trotman says that the total number of civilian respirators made by the end of the war was 97 million, at an average cost of 2/11d.

4.3 The charcoal used in all respirators made before the war was steam-activated coco-nut shell charcoal. The GC respirator used a low absorbitive capacity charcoal. Early in 1940 it was considered advisable to improve the protection afforded by all types of respirator against arsine, so steps were taken to impregnate the charcoal with silver nitrate. After February 1940 all canisters were thus provided with protection against arsine. Later in the war there was a shortage of coco-nut shells and charcoal for respirators was made from briquetted coal. This was subsequently impregnated with metals to enhance the protection against the low molecular weight war gases.

4.4 During the war it became apparent that arsenical smokes were reputedly of great German interest; the existing particulate filters were found to be inadequate. Consequently an additional filter known as the 'Contex', filled with a new filtering medium consisting of resin-impregnated wool, was development and manufactured on a large scale and fitted to the respirator (1). The 'Contex' container of aluminium was  $\frac{3}{4}$  inch deep, anodised green and attached to the original canister with sticky tape. The process for making the filter was specified by Porton in 1939 and the first were issued in May 1940. Between 1939 and 1943 a total of 15,139,000 were made (7). The 'Contex' was also fitted to earlier patterns of the Small Childs Respirator, the Baby Helmet, the Hospital Respirator, the Helmet Respirator and the Civilian Duty Respirator (10).

4.5 Resin-impregnated wool enabled the design of the Light Type Respirator for the Services to employ a facepiece mounted canister, but the increased demand for resin-impregnated wool that this generated led to a shortage of resin of the appropriate quality and during 1941 there is evidence that the production of resin-impregnated wool stopped and there was a short-term reversion to asbestos wool. There is no clear knowledge of how many canisters were thus affected nor whether the canisters were marked as Mk II, IIA, III, IIIA or Mk IIB or IIIB (see para 10).

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4.6 Other improvements were made to civilian respirators. When production started the best available particulate filter available was carded wool and asbestos which gave a protection of 93% against toxic smokes. The addition of the 'Contex' raised the protection to 99%. Late in 1940 the resin-impregnated wool filter was substituted for the wool-asbestos filter in the container; this made the 'Contex' redundant and improved the protection to 99.9%. Such containers were given a green band to distinguish them from the earlier black lacquered ones (10).

4.7 When the respirator was designed it was known that in time the stitch holes round the window could be a source of minor leakage. In 1940 latex luting was used to seal the stitch holes.

## 5. THE CIVILIAN DUTY RESPIRATOR (CD)

5.1 The CD respirator shown in Figure 2 was designed to be fitted with a CD Mk III canister with a higher volume activity charcoal than the GC respirator, otherwise the canister was very similar but carried a red painted band on the black lacquer. It had to provide one tenth of the protection afforded by the General Service respirator issued to the Services. This meant that it should protect for the same length of time, but against concentrations ten-fold less than those specified for the Service container. The original minimum limits set in 1933 were:

Phosgene	1/1000	(4.5mg/cubic metre)	25 minutes
Chloropicrin	1/5000	(1.5mg/cubic metre)	70 minutes
Particulate protection			90%

It was later found that by filling the GC container with charcoal of the quality used in the Service respirator the performance could be greatly enhanced and by 1939 the performance was:

Phosgene	1/500		60 minutes
Chloropicrin	1/500		65 minutes

A canister with this performance was used in the CD respirator.

5.2 The particulate filter was identical to that in the GC respirator. According to O'Brien 1.3 million CD respirators were in the course of manufacture in 1939. By the end of the war 4.5 million had been made at an average cost of 8/3d (10). Like the GC canister, those which did not need a



'Contex' were marked with a green band (10). Since resin-impregnated wool was introduced in 1940 it is likely that only one in three of the CD canisters contain asbestos.

## 6. THE SMALL CHILDS RESPIRATOR

6.1 The Small Childs Respirator, known as the "Micky Mouse" respirator was fitted mainly with a red facepiece and a blue canister, although some respirators were made with black facepieces. It is shown in Figure 3. Production started in February 1939 when the standard particulate filter contained asbestos so it must be assumed that all the early canisters contain asbestos. None of the ARP handbooks refer to the special canister of the Small Childs respirator as the GC Mk III or GC Mk IIIB yet Trotman (1), who played a large part in the development of the respirator, terms it as the GC Mk III and shows a photograph of the sectioned canister labelled in this way. All those samples seen by the authors have it impressed on the upper surface. Other evidence in old CDE files confirms that the GC Mk IIIB canister was used later for the Small Childs Respirator; this was asbestos free. O'Brien states that in May 1940 1.2 million child's respirators had been issued yet by the end of the war 3 million had been made (1) at an average cost of 4/6d. The third edition of the ARP Handbook on "Personal Protection" (10) says "all containers except those marked round the neck with a green band are fitted with a 'Contex'. This implies that those canisters with a green band are filled with resin-impregnated wool and are therefore free from asbestos (ie CG Mk IIIB canisters as described in para 10).

## 7. OTHER CIVILIAN RESPIRATORS

7.1 Other special respirators such as the Hospital Respirator (Figure 4), the Helmet Respirator (Figure 5) and the Respirator with Valve for those with respiratory problems were produced (Figure 6). There are no clear records to indicate what canisters were fitted to these respirators but the Baby Helmet (Figure 7) used the CD canister.

## 8. GENERAL SERVICE RESPIRATOR (GS)

8.1 By 1942 the Police, Fire and Rescue services were regarded as being in the front line and they were issued with GS respirators. The GS respirator (Figure 8) was declared obsolete by the services in January 1943 and when troops were issued with the Light Type respirator the GS respirator was refurbished and issued to non-field forces and possibly to other Civil Defence personnel.

8.2 In 1939 the canister of the GS respirator was the Type E Mk V and painted a buff colour. It contained a particulate filter composed of 80% merino wool and 20% blue asbestos. Following 1939 concern about the possible use of arsine the charcoal in the canister was improved and the GS standard canister became the Type E Mk VI and was painted red. The particulate filter was still merino wool-asbestos. The Type E Mk VI remained the standard canister for the GS respirator until the end of the war and according to Green and Thomas (2) 5 million were made.

#### 9. THE LIGHT TYPE RESPIRATOR

9.1 In 1941 a requirement was written by the Services for the Light Type respirator, which is shown in Figure 9. The success of the resin-impregnated wool in the later CD and GC respirators enabled the Light respirator to be based on the use of resin-impregnated wool. In 1943 the Light Type canister was improved to give superior protection against hydrogen cyanide and this canister L Mk II was marked with a white spot to differentiate it from the earlier ones. In August 1944 the performance was improved against cyanogen chloride but no new mark number was allocated to the canister. However, the date of manufacture stamped on the canister indicates to the initiated, whether or not the canister has the added protection (3).

#### 10. CONTAINERS OR CANISTERS: PRODUCTION DATA AND MARKING

10.1 Green and Thomas (2) list the following containers for both the GC and the CD respirators and the numbers made:

GC Mk II and IIA )  
 GC Mk III and IIIA ) 80% Merino wool and 20% White asbestos.  
 CD Mk III and IIIA ) 70 million

'Contex' Resin (15-25%) impregnated merino wool.

GC Mk IIB )  
 GC Mk IIIB ) Resin (15-25%) impregnated merino wool.  
 CD Mk IIIB ) 4 million

Trotman says that 93 million GC and CD respirators were made, yet Green and Thomas say that only 74 million canisters were produced. During the war the window on the Civilian respirator was found to be a weak feature and at one time as many as 1 in 5 was unserviceable on this account. Sound canisters were transferred to new facepieces and this may account for the discrepancy in the numbers quoted. The figures given by Green and Thomas (2), however, suggest that about 5 out of 6 Civilian canisters will contain asbestos.

10.2 Recent examination of about 15 canisters by one of the authors (KPN) showed that they are not marked with the Mark Number but they are marked with a symbol such as MB xy where xy is a number between 36 and 45. By comparison with other dated components on the respirators it is apparent that the number is the year of manufacture.

10.3 The Mark Number of the canister can be established fortuitously by means of information provided in ARP Handbook No 1 "Personal protection against gas" (8, 9, 10), abstracts of which are given in Appendix A. Unfortunately this does not enable one to determine the content of the particulate filter since both Marks II and III were filled with merino wool-asbestos and then later with resin-impregnated wool, but the presence of a green band on such canisters indicates that they are filled with resin-impregnated wool.

10.4 The reports quoted do not shed any light on the significance of the A and B designation of the canisters. In the GS canisters letters were used to indicate the source of the charcoal (13). It may be that this applies to the civilian canisters also or it may signify different charcoal impregnation to provide protection against HCN and cyanogen chloride. An early edition of "Care and Repair of Respirators" dated 1939 (11) says that "the container may be supplied with a white band indicating charcoal supplied after a certain date". The implication of this is that canisters with a white band will almost certainly contain asbestos because this was the particulate filter in use at that time.

## 11. FOREIGN RESPIRATORS

11.1 During World War II the Military Intelligence branch of the War Office issued reports on the chemical warfare equipment developed by the Germans (14), Japanese (15) and Italians (16). These reports indicate that with the exception of the Italians, who used resin-impregnated wool and viscose rayon as a particulate filter the use of asbestos-wool was common in WWII respirator canisters. Asbestos-wool was used in Soviet respirators in WWII and it is still used (17). V  
10

## 12. CONCLUSIONS

12.1 Both blue and white asbestos were used in WWII respirator canisters.

12.2 On the basis of the information in paragraphs 4-10 it is possible to lay down the following guidelines to identify those British canisters which contain asbestos and those which do not. The guidelines err on the side of safety.

- a. Whilst we do not know how many of the civilian respirator canisters were produced in any year all civilian canisters marked MB 36, MB 37, MB 38, MB 39, and MB 40 almost certainly contain white asbestos.
- b. All canisters fitted with a 'Contex' during the war almost certainly contain asbestos.
- c. All canisters marked MB 41, MB 42, MB 43, MB 44 or MB 45 almost certainly are free from asbestos. Because of the possible delay in introducing new specifications to manufacturing practice those marked MB 41 might be treated with caution but one author (KPN) found 8 out of 8 canisters marked MB 41 were identified with a green ring. They were therefore free from asbestos.
- d. All Mk 4 canisters (those with a smooth rounded external end rather than a seamed end) were made after the war and are free from asbestos (see Appendix A).
- e. All 'Contex' containers are free from asbestos.
- f. All canisters with a green band are free from asbestos. This includes the smaller, blue painted, canister for use with the Small Childs Respirator. The green band in this case is painted round the neck of the container.
- g. Civilian canisters marked with a white band almost certainly contain asbestos.
- h. All Light Type Service respirator canisters are free from asbestos.
- i. All E type canisters (those connected by a rubber hose to the facepiece of the GS respirator) contain blue asbestos.

### 13. DISCUSSION

13.1 Creasey (18) showed that asbestos bearing filter materials such as that used in the Service E Mk VI canister release asbestos fibres of respirable size range but, under the conditions of the experiment where canisters were subjected to simulated breathing and to movement and vibration, the concentrations of fibres released were much lower than the H M Factory Inspectorate limit for crocidolite (blue asbestos). The limits for factory workers were based on exposure for 8 hours a day for a working life whereas respirators are worn for only short infrequent periods. Creasey, rather

strangely, was unable to find asbestos in any of the civilian canisters he tested so no measurements exist of the behaviour of GC or CD canisters under simulated breathing but it must be assumed that they behave similarly to those of the GS respirator.

13.2 Asbestos fibres are only removed from the supporting wool fibres by considerable forces such as those generated by air flowing past the fibres. Undisturbed canisters are unlikely to release asbestos fibres.

13.3 Canisters fitted with a 'Contex' will almost certainly not lose asbestos fibres via the inlet, which is protected by the 'Contex' container, but fibres could leave the canister via the inlet valve at the proximal aperture, within the facepiece, since this provides only a modest static seal. In use, during inspiration, this valve opens wide, allowing small fibres of asbestos to move with the air stream whence they may pass into the lungs of the wearer.

13.4 Canisters which are required for display can readily be sealed to prevent the egress of asbestos fibres by using a silicon foam sealant on the inlet and outlet of the canister. The asbestos regulations (19) require that such canisters are correctly labelled to indicate that they contain asbestos. Clearly such respirators must not be worn and they should be labelled to this effect.

13.5 In 1989 Hampshire museums arranged an exhibition entitled Hampshires War. In this civilian respirators which had been rendered safe were readily available for wear by children (20). A leaflet associated with this exhibition was entitled "World War 2 Gas Masks Made Safe!".

#### 14. RECOMMENDATIONS

14.1 Civilian and Service respirators, identified by the guidelines in para 12 to have canisters known to be filled with asbestos, should not be worn and they should not be played with by children.

14.2 Civilian respirators, contained in a museum, display or collection of military equipment, which are fitted with a canister without a green band and GS Respirators fitted with red-painted E Type Mk VI canisters should be sealed with a suitable sealant and labelled in accordance with the asbestos regulations so that they can be disposed of safely and in accordance with the regulations when they are no longer required. Ideally any display cabinets containing such canisters should carry a notice to the effect that certain

canisters are sealed and labelled distinctively because they contain asbestos. Under no circumstances should respirators with sealed canisters be worn.

14.3 Canisters containing asbestos which are no longer required must be disposed off as controlled waste. Most Local Authorities operate a system for the safe disposal of asbestos and they will offer advice on the procedure to follow.

14.4 Civilian respirators fitted with canisters marked with a green band or with the Mark 4 canister and the Light type Service respirator can be worn, provided that suitable precautions are taken to sterilise the respirator before it is used by another person. The efficiency of the particulate filter may have decreased significantly since it was manufactured and it should not be used in the hope of providing protection against a toxic smoke, cloud, industrial gas or to afford protection against domestic gas or those gases in car exhausts.

14.5 Civilian respirators fitted with canisters marked with a green band and Light type Service respirators may be handled, displayed and disposed of without any undue care.

#### 15. ACKNOWLEDGEMENTS

The advice of                      has been invaluable in the writing of this report. We are also grateful to                      and                      of Protection Division for helpful discussions, the opportunity to inspect the collection of respirators held in that Division and to see unpublished data on the presence of asbestos in five canisters which had been subject to a detailed investigation.

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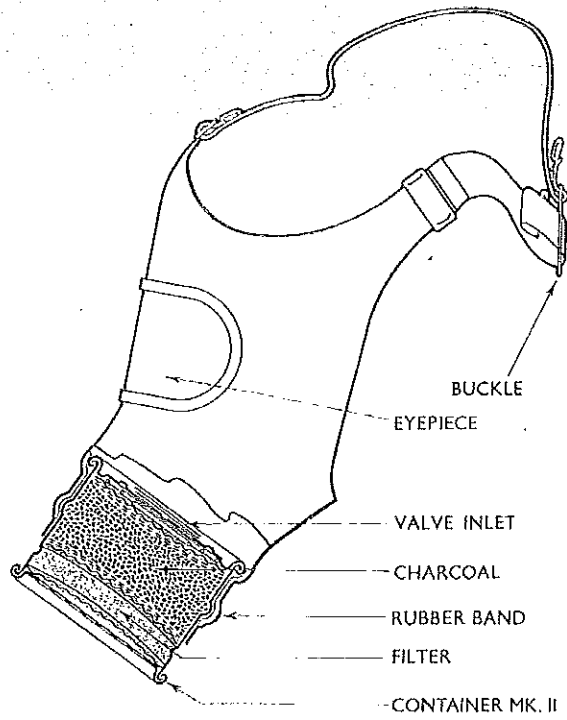
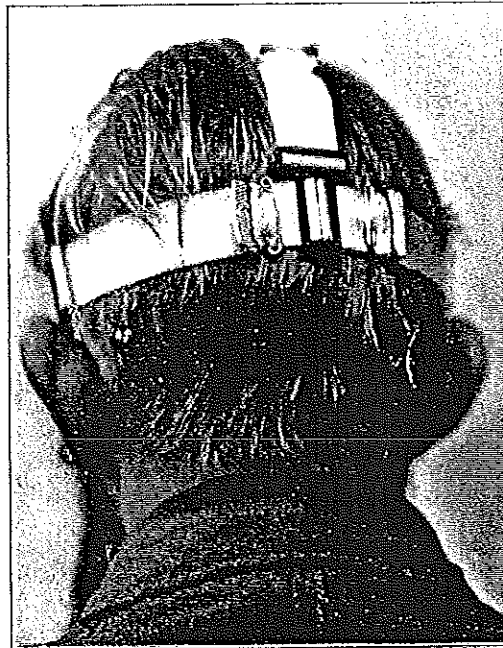


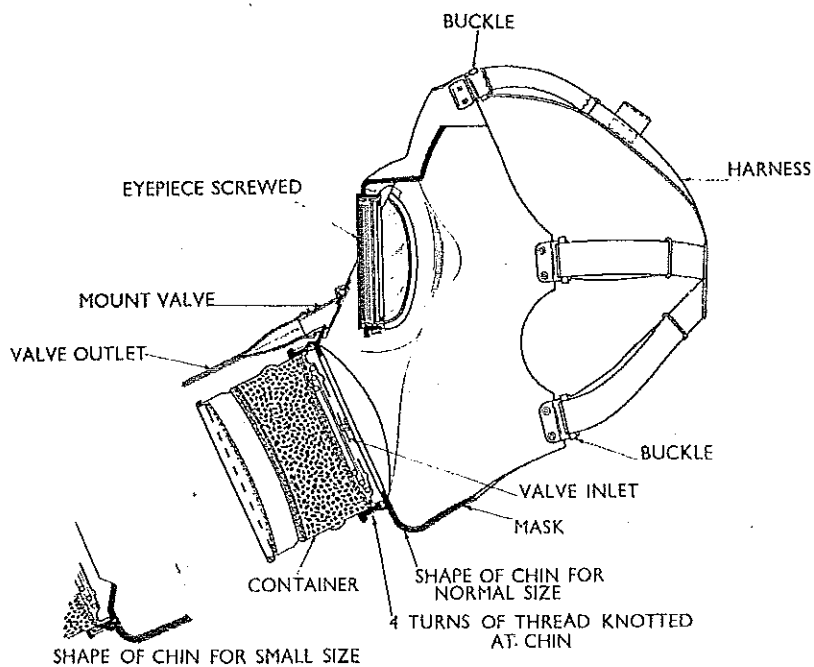
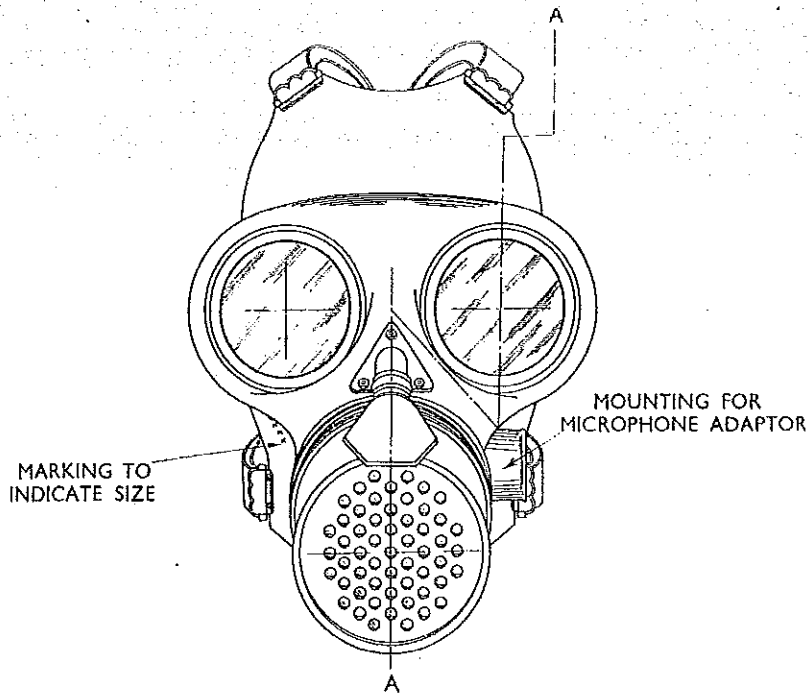
FIGURE 1



### GENERAL CIVILIAN RESPIRATOR

The diagram shows a section through the Mark II container and the method of obtaining an airtight connection between the rubber facepiece and the container. Photographs show the correct position of the facepiece to give maximum comfort and visibility, also the position and adjustment of head harness.

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**FIGURE 2**

**CIVILIAN DUTY RESPIRATOR**

The C.D. respirator was designed for civilian personnel employed on special duty such as first aid, and certain factory and dock workers. The container gives a somewhat lower degree of protection than the general service, but the facepiece is designed on similar lines so as to be suitable for long periods of wearing.

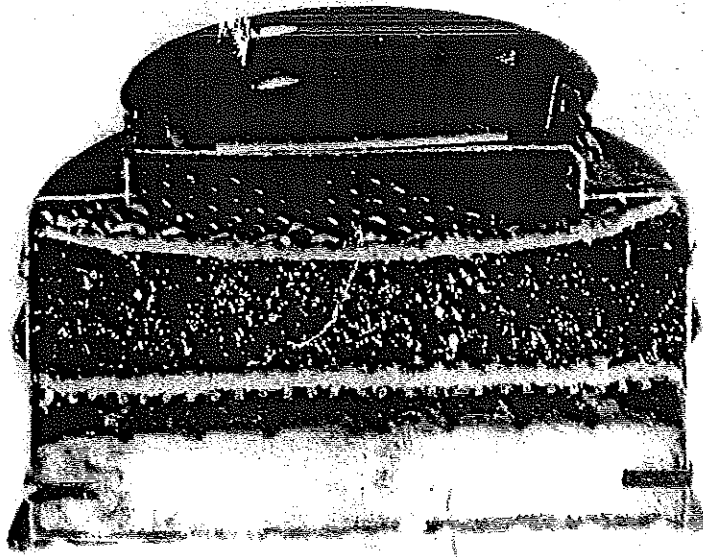
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SECTION OF CONTAINER GC MK III  
(CHILDS)



SECTION OF CONTAINER GC MK III (CHILDS)



FIGURE 3

THE CHILDS RESPIRATOR

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FIGURE 4

THE HOSPITAL RESPIRATOR

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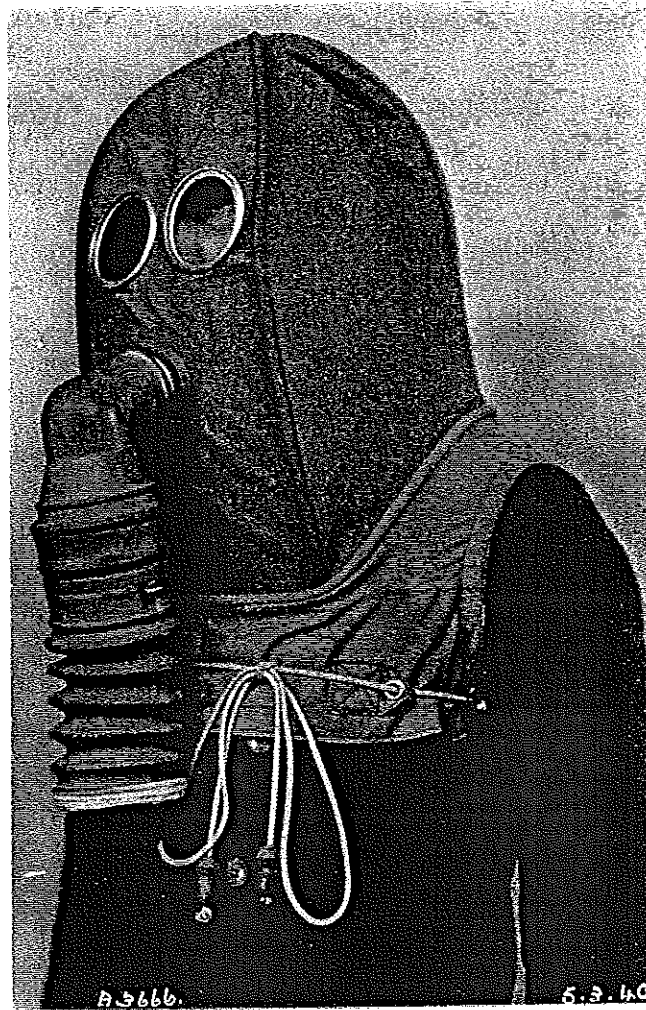


FIGURE 5

THE HELMET RESPIRATOR

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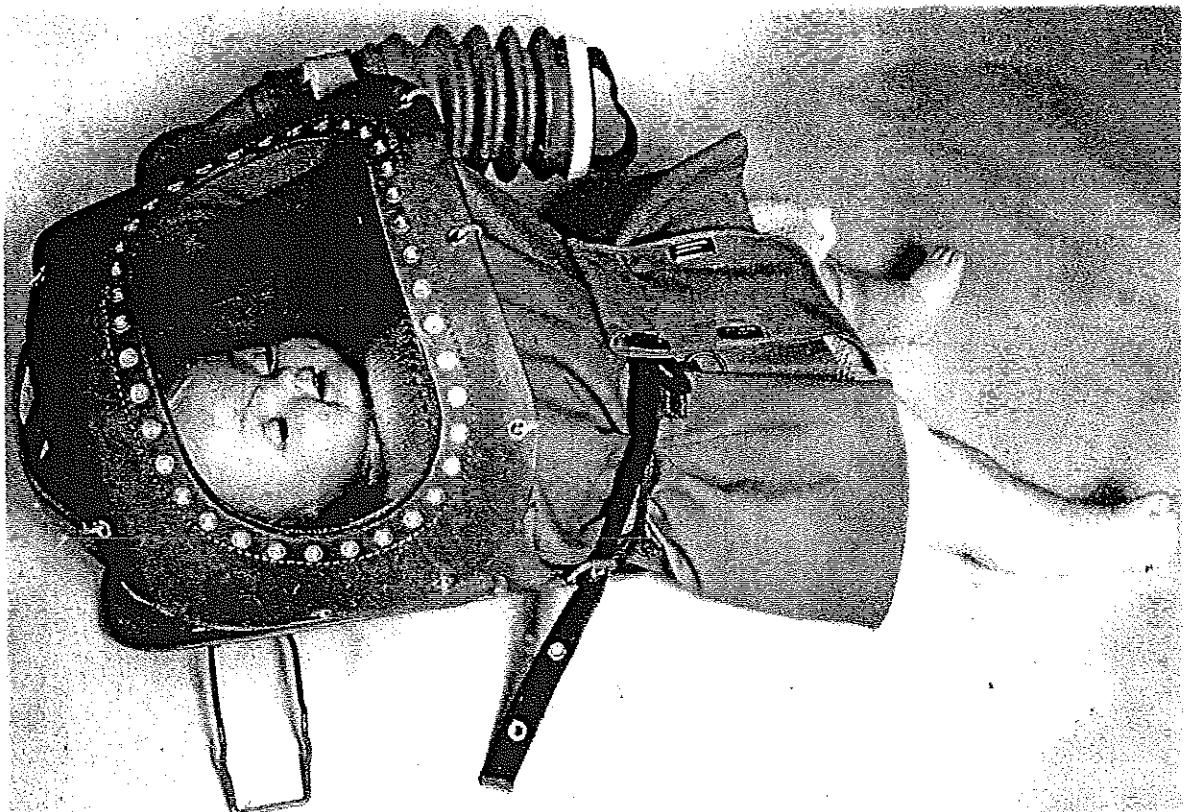
FIGURE 6

CIVILIAN RESPIRATOR WITH VALVE

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FIGURE 7

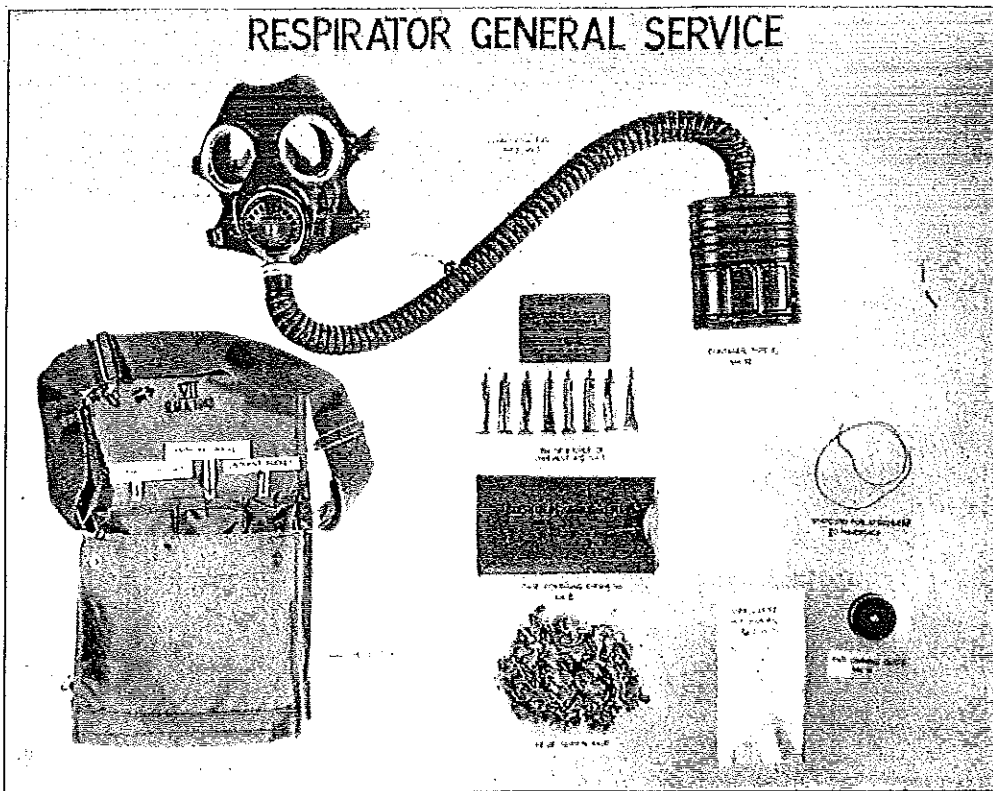
THE BABY HELMET

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GENERAL SERVICE RESPIRATOR, MARK VA, 1942

Complete equipment of the respirator as supplied in 1942, including moulded rubber tube simplified Haversack Mark VII with anti-dim pocket at the top.

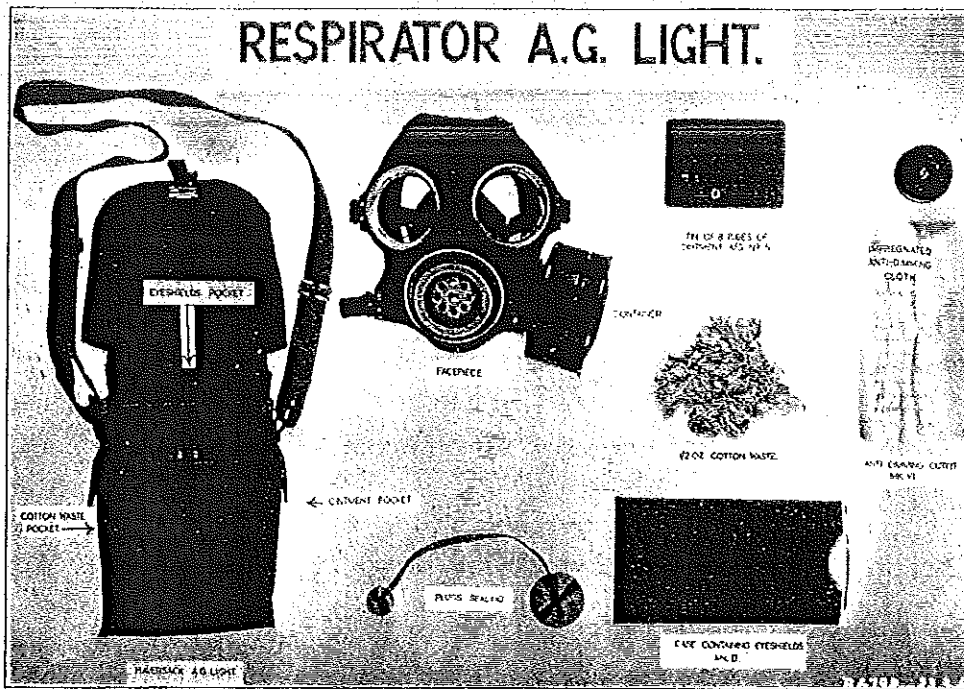
FIGURE 8



Note whipcord has replaced the belt and sling has been simplified. Eyepieces modified to give smooth outside ring.

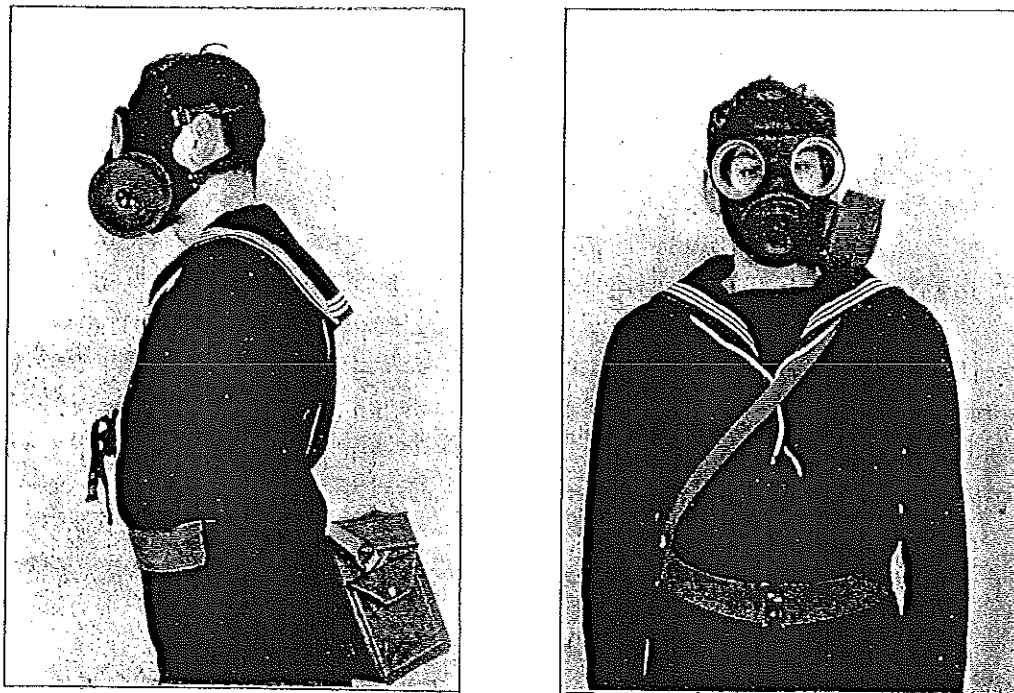
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Complete equipment for the light respirator which was designed originally for assault troops who required a lighter equipment than the general service respirator, also a container which could be easily sealed against the ingress of water for men having to wade. The haversack can be carried vertical or horizontal at the back of the belt.

FIGURE 9



The light respirator is designed to give adequate protection to combatant troops and yet not be too heavy to be supported comfortably on the face. The container is so placed to facilitate the use of the rifle. The protection afforded against high concentrations is about half that of the general service and double that of the general civilian container.

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