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V. ECKHARDT ET AL
GAS MASK FILTERS AND THE LIKE
Filed July 22, 1939

Serial No.
286,002
3 Sheets-Sheet 1

FIG. 1.

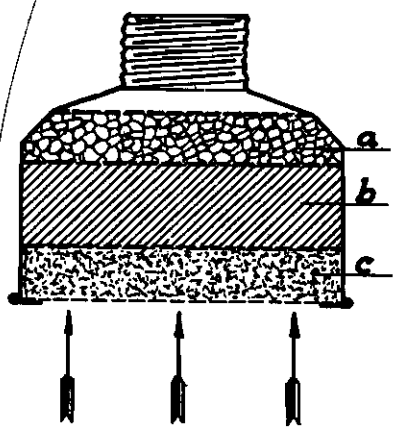

FIG. 2.

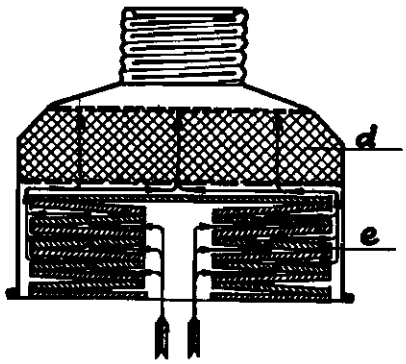

FIG. 3.

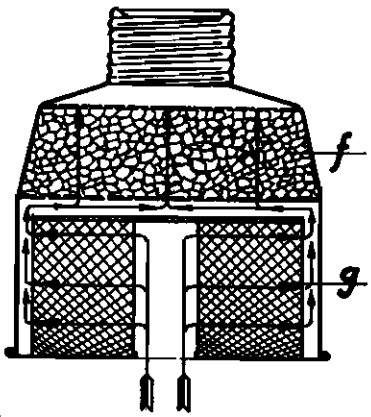

FIG. 4.

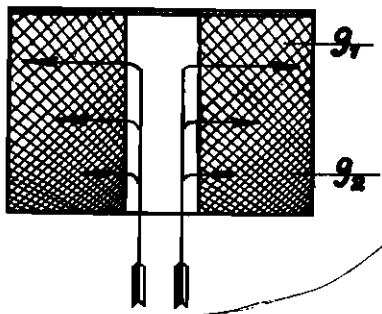

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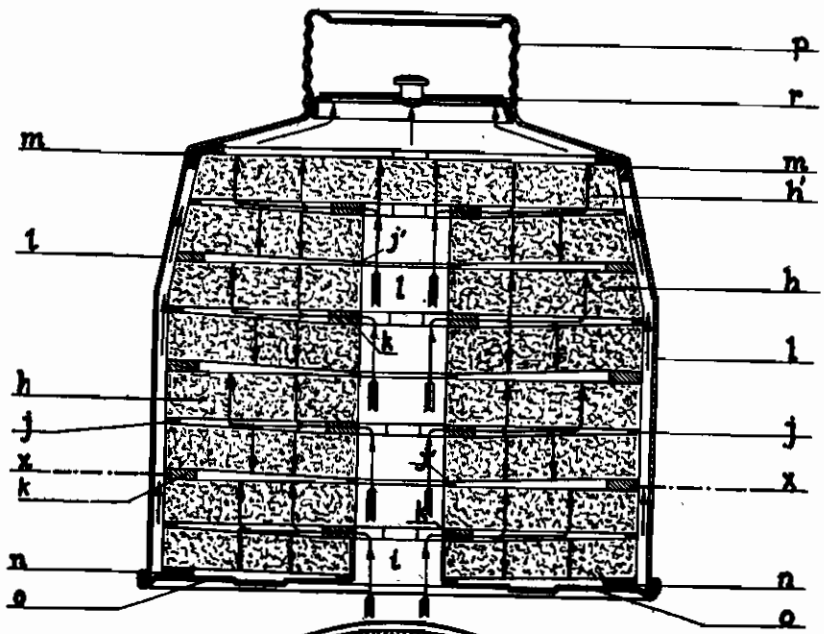
FIG. 5.



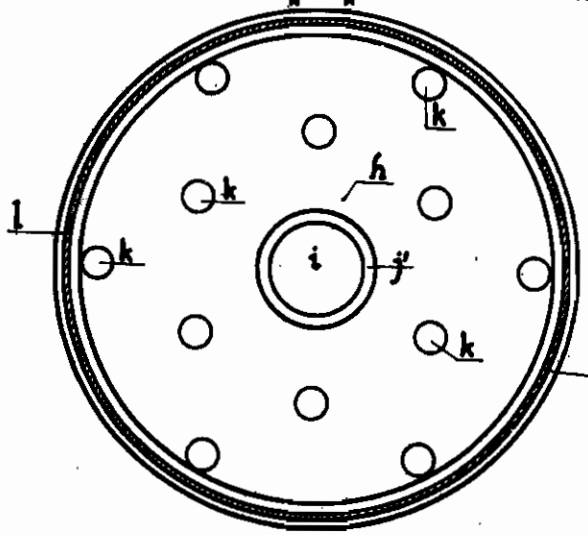


FIG. 6.

FIG. 7.

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FIG. 8.

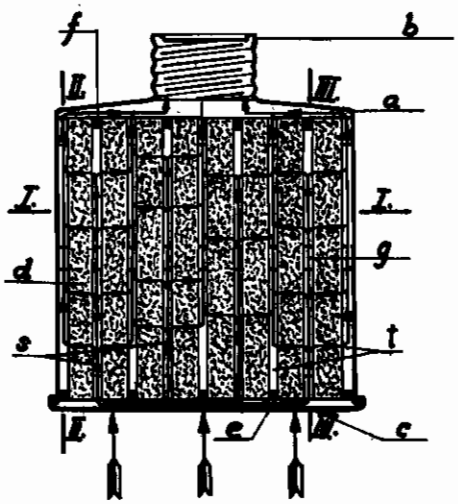


FIG. 9.

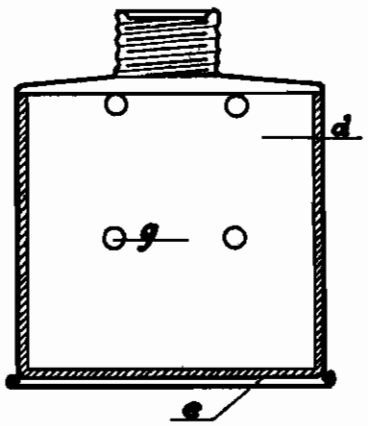


FIG. 10.

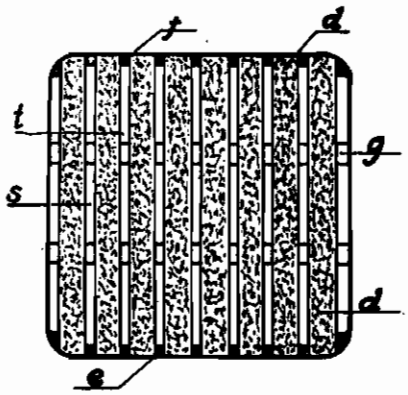
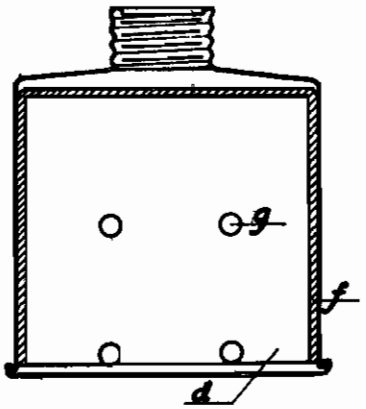


FIG. 11.



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ALIEN PROPERTY CUSTODIAN

GAS MASK FILTERS AND THE LIKE

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Application filed July 22, 1939

This invention relates to filters for extracting from the atmosphere noxious gases, vapours, liquids or solids contained therein.

According to the present invention there is provided a universal filter insert or filling for filters which are adapted to serve as a protection against noxious gases, vapours, liquids and solid substances in the atmosphere, characterised by the fact that the effective surfaces or walls of the filter insert or filling are formed from a homogeneous filtering mass comprising a material adapted for mechanical filtration, such as paper, cellulose fibres, artificial fibres or the like and acting at the same time as carrier for substances capable of effecting absorptive and adsorptive purification of the noxious components of the atmosphere.

The term "absorptive" refers to the removal of the noxious gases by chemical methods, for example by means of chemicals or reagents capable of neutralisation, hydrolysis or other decomposition of noxious gases; such chemicals are for inst. potash, soda, thiosulphat, hexamethylentetramine, ethylendiamine and many others. The term "adsorptive" refers to the physico-chemical filtration by means of adsorbant materials, such as active charcoal, silica gel etc.

In order that the invention may be clearly understood and readily carried into practice, reference will now be made to the accompanying drawings.

Figure 1 represents a gas mask filter of an early type.

Figure 2 represents a later development of gas mask filter.

Figure 3 represents a further improved form of filter, of which

Figure 4 is an explanatory diagram.

Figure 5 illustrates by way of example a gas mask filter according to the present invention.

Figure 6 represents a section along the line x—x of Fig. 5.

Figure 7 is an explanatory diagram referring to Figs. 5 and 6.

Figure 8 illustrates another embodiment of the invention in vertical section.

Figure 9 is a section along the line II—II of Fig. 8.

Figure 10 is a section along the line I—I of Fig. 8.

Figure 11 is a section along the line III—III of Fig. 8.

Chemical, physico-chemical and mechanical filtration is used for removing from the atmosphere noxious substances that may be contained therein in gaseous form or as vapour or a cloud of solid or liquid materials.

Gas mask filters manufactured for this purpose usually consisted originally of three separate successive layers, as indicated in Figure 1, viz: a layer a consisting of a porous mass, e. g. diatomite, impregnated with suitable reagents for combining with and rendering innocuous chemically reactive substances such, for example, as phosgene; a layer b of an adsorbent mass, e. g. active carbon, whose especial function is to retain less reactive substances, such for instance as chloropicrin; and a layer c consisting of fibrous material which has been prepared either by a dry method in a free, stratified state, or else by a wet method in the form of solid bodies, the function of this layer being to retain by mechanical filtration solid and liquid substances that are distributed in the atmosphere as a mist or cloud, such for instance as diphenyl arsenious chloride.

A filter of this kind has the great disadvantage that the porous layer a constitutes a large ballast owing to its volume and weight, and on the other hand the strongly compressed layer of this carrier becomes caked together if stored for a length of time owing to the reagents therein and the moisture and pressure, and thus endangers the fundamental properties of the filter, since its resistant life is shortened and its resistance to inhalation increased.

Later on a substantial improvement was effected by means of the construction that is frequently used nowadays, in which the porous carrier is reduced in bulk or wholly eliminated and replaced by active carbon into which the appropriate reagents are introduced directly.

The filter made up in this way (Figure 2) thus comprises only two layers, viz. an absorptive-reactive layer d of impregnated active carbon and another layer e for mechanical filtration, which at the present time is usually made of special filter paper having suitable properties, from which filter inserts in the form of bellows are made by joining together round sheets of filter paper with a hole in the center alternately at the edge and in the middle to form a closed body. This kind of filter has the disadvantage that it is necessary on the one hand to pay careful attention to the size of the grains of active carbon and on the other hand to use a special cellulose for the arsenious insert e in order to keep the resistance to respiration of the filter within the limits of the demands made thereon.

According to yet another proposal that has been made it is advantageous to use moulded hollow filter bodies made of a mixture of active carbon and cellulose, that is to say a combination of the second and third filtration stages of the first construction (see above), whilst the chemical or reactive layer is unchanged, so that a two layer filter is again obtained, consisting (Figure 3) of a porous mass with reagents (layer f), and a hollow filter body g composed of a mixture of active carbon and cellulose for the adsorption and mechanical filtration.

This type of filter has found no practical application however, on account of the fact that the filtration in the part g occurs in the direction of the stratification of the individual components (Figure 4;) actually the mixture of cellulose and active carbon is unevenly distributed on account of the difference in specific gravities, the upper strata g_1, containing more cellulose and less active carbon and the lower strata g_2 more active carbon and less cellulose, so that the filtration proceeds irregularly in different parts g_1, g_2.

It is an object of the present invention to remedy all the disadvantages of the previously known filters set out above and to provide a universal filter insert for all kinds of noxious substances, that is to say a filter insert having small resistance to respiration and long useful life and containing no substances that are ineffective for filtering purposes.

This is achieved according to the present invention by forming the effective walls or surfaces of the filter insert from a homogeneous filtration mass composed of a mixture of substances capable of the absorption, adsorption and mechanical filtration of noxious agents in the atmosphere.

The filter is constructed in such a way that the filtration occurs at right angles to the direction of stratification in the filtering mass, so that the air is uniformly exposed to all the constituents of the mass (Figure 3).

Such a filtering mass may be composed for example of cellulose mixed with active carbon and reagents (e. g. potash); this term "reagents" also including moisture, i. e. a certain water content in the filter mass, which has a great effect on the resistive life of the filter to various lethal gases.

Thus in accordance with the invention the fibrous substance (e. g. cellulose in form of paper, felt, artificial fibres and the like) acts as a carrier not only for active carbon but also for chemicals and/or water, thus achieving all-round effectiveness against all kinds of noxious substances.

The universal filter masses according to the invention can be produced by a wet process, in which the various constituents, e. g. fibrous substance, active carbon and solution of the reagent used, are weighed out and thoroughly mixed in a hollander. The thin paste thus formed is worked further on a sieve, being kept constantly in agitation, so as to remove the excess solution of reagent, and the mixture is precipitated on the sieve in the form of a very homogeneous slab or sheets. The reagent may be naturally added also in other forms than in a solution.

The proportions of the constituents of the filtering mass depend on the filtering properties required, and especially on the desired ration between the resistive life relative to acid substances such as phosgene, and chemically indifferent substances such as chloropicrin.

A non limitative example of the composition of the filtering mass is:

	Per cent
Cellulosic matter (by weight)	30
Active charcoal	50
Potash	5
Moisture	15

The percentage of potash or other reagents may be reduced and the content of moisture correspondingly increased. The ratio of the cellulose matter to active charcoal depends largely on the specific properties of each of these materials and has to be determined separately for each given case.

In using different proportions of moisture and/or reagents we control the ratio between the resistive life of the filter relative to phosgene and to chloropicrin, which are representatives of the main groups of noxious gases. If the ratio 1:1 is desired, we recommend for instance 17 to 19% of water in the filtering mass, and for the ratio 1:3 only 10% of water. If a longer resistive life against phosgene is required than against chloropicrin, the content of water may exceed 20%. The content of moisture may be easily varied to particular requirements in a filter which is ready for use as well as the content of chemicals.

In order to obtain universal efficiency of the filter against different noxious substances, the ratios of the individual constituents of the mixture will preferably be such that the resistive life of the filter relative to weakly reactive gases (e. g. chloropicrin) does not fall below the resistive life of the filter relative to reactive gases (e. g. phosgene).

The granulation of the active charcoal is chosen according to the type of fibrous material used. For long and thin fibres we use charcoal of very small grain size and nearly in powder form (0.01 mm.); of the cellulosic material has short and thick fibres, it is better to use a larger grain size and only a very small proportion of small grain size.

The thickness of the filter layer relative to its area depends on the type of cellulose used, the type of active carbon, the degree of granulation of the latter, and the chemicals employed. It has to be determined separately for each particular purpose, and in making this calculation one must also take into account the resistance to respiration of the filtering plates and the absolute capacity to retain the poison gas cloud (arsines).

It is then possible to make up from the filter mass obtained filter inserts which are characterised by their ability completely to purify the atmosphere although they consist merely of plates or slabs of filtering material without any separate layers of chemically active fillings with carriers (sieves and the like).

By drying the slabs thus obtained so that they only possess the desired moisture content it is possible to obtain a mass having properties suitable for making universal filters of homogeneous nature which can be suitably arranged according to the size and shape of the filter, both superficially and spatially.

Figures 5 and 6 of the drawing illustrate by way of example an embodiment of the invention in vertical section and in horizontal section on line x—x. The filter insert consists of filter layers h composed of a mixture of fibrous material, active carbon or like absorbent substance, and a reagent or reagents for chemically combining with or decomposing noxious substances in the atmosphere, for instance potash and a suitable moisture content, so that mechanical filtration (e. g. of arsine and other smoky substances), and chemical (e. g. for phosgene) and adsorptive actions (for less reactive gases and vapours) take place simultaneously in these layers. These filtering walls or layers are assembled to form an insert, as indicated in Figure 5, where the walls or layers are in the form of discs with stamped-out central openings i, with the exception of the wall h^1 which closes one end of the central passage and is made without an opening. These discs are joined together alternately in the middle and at the pe-

riphery by rings j, j^1 to form a bellow-like structure, and the rigidity of the structure is ensured by supporting spacers k or by other known means. The insert thus formed is placed firmly in the filter case l, preferably in such a manner that the filter discs h are not in direct contact with the walls of the case; in the embodiment illustrated the insert is supported relative to the case l by means of supports m at the top and n at the bottom. By removing the bottom o the insert can be withdrawn from the case and replaced. The arrows indicate the path taken by the air during the filtration. The case l has a pipe connection p in which a respiration valve r is provided with a screw-thread for the attachment of the gas mask.

Fig. 8 to 11 illustrate another embodiment of a filter according to the invention. This filter consists of a plurality of chambers which are connected alternately with the outer atmosphere and with the interior of the gas mask. These chambers are respectively those designated s for vitiated air, and those designated t, for purified air. In Fig. 8–11, a is the filter casing, b a screw-threaded union, c a removable bottom plate with openings for admission of the air, d are layers of a filtering mass according to the invention, e spacers between the filtering plates, d, forming chambers t, f similar spacers forming chambers s, and g are supports between the plates d in chambers s and t.

The filters according to the invention are not however, limited in their application to the particular constructions of a gas mask insert illustrated and described; on the contrary they may be used in varied forms for individual or collective filters. The filtering mass for use as a filter insert according to the invention need not always be made up as a closed filter body, but can be placed directly in the filter case in any desired state to act as a filling.

With the aid of filters of the types described the following advantages in particular are achieved:

(1) Improved performance for the same filter content (about 20% over the current type).

(2) Reduced resistance to respiration in view of the greater filter area (about 50% of the usual constructions).

(3) Reduced weight of filter owing to the elimination of the sieves (about 20% of the total weight of the filter).

(4) Substantial reduction in price (to about 30% of the previous manufacturing costs), since cheap domestic fibrous substances can be used.

(5) Absolute resistance to corrosion, since the filtering mass does not come into contact with filter walls.

(6) Absolute resistance to moisture, since comparatively thick filtering plates can be used.

(7) Ready interchangeability of the whole filtering mass without damaging the filter case with connection piece.

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