A. B. LAMB AND C. R. HOOVER.

GAS DETECTOR.

APPLICATION FILED DEC. 28, 1918.

1,321,062. Patented Nov. 4, 1919.

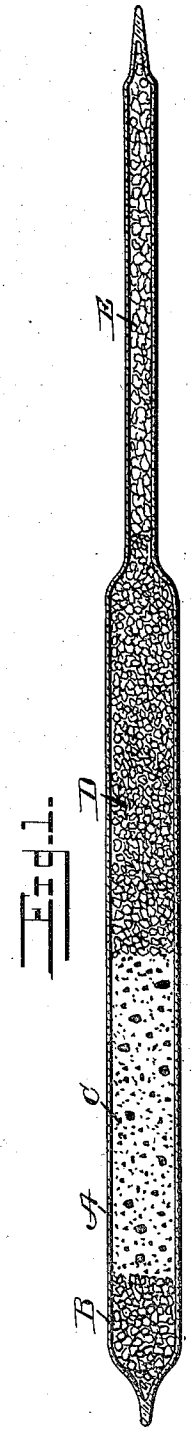


Fig. 1.

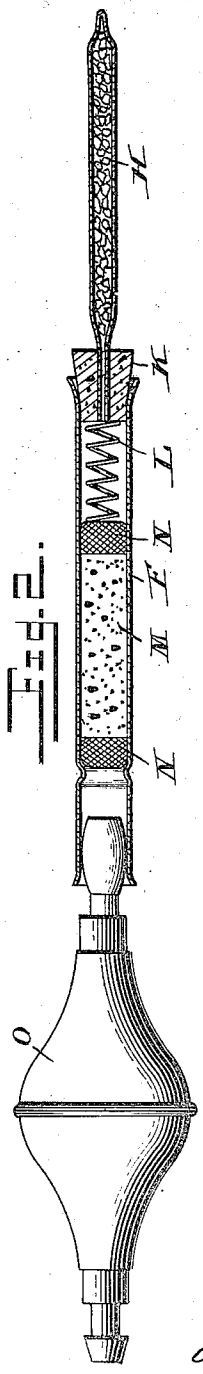


Fig. 2.

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GAS-DETECTOR.

1,321,062. Specification of Letters Patent. Patented Nov. 4, 1919.

Application filed December 28, 1918. Serial No. 268,751.

To all whom it may concern:

Be it known that we, ARTHUR B. LAMB, Lieut. Col., and CHARLES R. HOOVER, civilian, Chemical Warfare Service, U. S. Army, citizens of the United States, and residing at Washington, D. C., and Middletown, Connecticut, respectively, have invented certain new and useful Improvements in Gas-Detectors, of which the following is a specification.

This invention relates to methods of and means for detecting oxidizable gases such as carbon monoxid, arsin, phosphin, ammonia, and many others, and also relates specifically to methods of and means for detecting small quantities of carbon monoxid.

One of the objects of the invention is to provide a compact and self-contained unit for the detection of the above gases, one that can be used for the detection of harmful gases in mines, industrial plants, etc.

The invention consists in making use of a very sensitive form of the material described and claimed by us in application Serial No. 268,750, filed concurrently herewith, in such manner as to permit the observation of the color change characteristic of the material and in such manner as to allow the material to undergo this change only in the presence of a particular gas.

Detectors prepared in accordance with the present invention are shown in the accompanying drawings in which the figures show two types of prepared units for the detection of carbon monoxid, Figure 1 showing the arrangement of the materials in a single tube and Fig. 2 showing a similar arrangement of materials but having the several materials in separate and detachable tubes, so that any one of them may be removed and a fresh one substituted when it is considered necessary.

In the codepending application above referred to, there are described processes of making a material which, for want of a better name, has been named "hoolamite". The composition of the material varies somewhat according to the purpose for which it is to be used, but only in the proportions of the several constituents. The final product is a mixture or compound, or both, of oxids of iodin, oxids of sulfur, and water. There may be added to this a small amount of iodin and a solid supporting substance, depending upon the use of the product. The solid supporting material may be pumice or asbestos but it should be understood that any suitable material may be used in the place of these.

In the preparation of the new product, fuming sulfuric acid and iodic anhydrid are used in proportions varying from a small amount of one in a relatively large amount of the other to a relatively large amount of the first with a small amount of the second. The most advantageous mixtures for most purposes, however, lie in the range of from 3 to 1 of the acid to 1 to 10 of the iodic anhydrid. The particular proportions to be chosen will depend upon the use. For example, in respirators, it is desirable to use a composition having not too great a proportion of fuming sulfuric acid because of the tendency to give off sulfuric anhydrid. For other purposes it may be that a small amount of sulfuric anhydrid in the gas after treatment will not be objectionable and in such cases a greater proportion of the acid my be used with an increase in the sensitiveness of the composition.

In these processes involving the use of pumice as a carrier it has been found to be an advantage to heat the pumice immediately before mixing, as this allows a better mixing and produces a somewhat better product.

Instead of first mixing the acid and pumice with the subsequent addition of the iodic anhydrid, the latter may be thoroughly mixed dry with the pumice and the fuming sulfuric acid then added and the whole mixed until uniform.

Further, instead of proceeding in the manner indicated in the last paragraph, the iodic anhydrid may be prepared for reaction by saturating the granular or fragmentary carrier with iodic acid in water, evaporating to dryness, and continuing the heating to dehydrate the acid, leaving iodic anhydrid on the carrier. This is then mixed with the fuming sulfuric acid as before indicated.

In case a solid product without a support is desired, about equal parts of iodic anhydrid and fuming sulfuric acid are allowed to interact at a slightly elevated temperature or allowed to stand in contact for a few days until a hard uniform product is ob-

tained. This is then broken in pieces of suitable size and is then ready for use.

A liquid product may be produced by increasing the proportion of fuming sulfuric acid.

The product is a white solid, except in those cases where a large proportion of fuming sulfuric acid has been used and when acting as an oxidizing agent undergoes a color change from white to green to brown. This color change is not permanent but disappears on standing and the material may be repeatedly reused until the iodic oxid has been entirely reduced. It is strongly corrosive and therefore should be kept in containers of glass, porcelain, etc.

The material prepared in the manner indicated in the above mentioned application may be modified as to its sensitiveness by the variation of the amounts of the constituents, as indicated in the description.

In general, the oxidizing absorbent is prepared by thorough mixing of iodic anhydrid and strong fuming sulfuric acid with or without the addition of a carrying material, such as asbestos or pumice, depending upon whether the constituents are so proportioned as to produce a liquid or a solid product. In some cases a liquid product is desirable, but, in most cases, if the product is a liquid, it must be absorbed in such a carrier as above mentioned in order that gases may be suitably contacted therewith, such as by passing them through it.

In making up a product to be used in detecting small amounts of oxidizable gases mixed with large quantities of diluting gases, it is necessary to so proportion the constituents as to give a very sensitive product. This is done by increasing the proportion of the fuming sulfuric acid, as, within certain limits, the greater the proportion of the fuming sulfuric acid, the more sensitive the product.

As a specific example of the preparation of a product which is suitable for use in the detection of, *e. g.*, carbon monoxid, the following method is given:

30 parts of pumice stone, freed from organic matter and water by ignition, and passing through a 20 mesh but retained by a 40 mesh screen, are treated with 50 parts of fuming sulfuric acid, 60% sulfur trioxid and after thorough mixing, 10 parts of iodic anhydrid are added and thoroughly mixed. The product is a white granular solid.

In order to increase the sensitiveness it is sometimes advantageous to add a small proportion of iodin, from .25 to 2% being sufficient.

Material prepared in this method reacts instantly to produce the characteristic green color with gases of a concentration of 1.0% and within 15 seconds with concentrations as low as 0.01%.

In choosing proportions of the constituents for the purpose of making a detector as distinguished from an oxidizing absorbent, it is necessary to bear in mind that a larger proportion of acid makes the material somewhat more sensitive, and makes the material less readily harmed by moisture because of the greater amount of the water absorbing acid present. Another consideration is that proportions should be chosen which will make the color change more pronounced, *i.e.*, the material should be sufficiently white to enable one to easily perceive the green tinge caused by a small amount of oxidizable gas.

In using the above material for the detection of oxidizable gases it is only necessary to pack some of the material in a glass tube and pass the gases therethrough, whereupon the presence of the oxidizable gases will cause the characteristic color change to green and if in sufficient quantity, to brown. It is better, however, when making use of the material, to protect it from the moisture usually present and this may be done by placing in the tube on either side of the material, a drier such as pumice in which has been absorbed sulfuric acid.

A more specific application of the material is its use in the detection and approximate estimation of the carbon monoxid present in gas mixtures. This use may be carried out by preparing a tube containing a layer of active charcoal or other suitable absorbent and a layer of the oxidizing absorbent material and passing gases through the tube in such manner that they pass through the charcoal first and in measuring the amount passed. The charcoal will absorb from the gases substantially all of the oxidizable gases except carbon monoxid and hydrogen and the latter will not react with the material. As the color change of the material is uniform and gradual, the extent of the change will indicate how much carbon monoxid has been acted upon.

It is, of course, evident that tubes containing the several substances mentioned may be previously prepared and used singly or together as indicated above.

In the drawings there are shown two suitable arrangements of apparatus which may be used for the detection and approximate estimation of carbon monoxid.

The device shown in Fig. 1 is one not intended to be renewed after once having been exhausted. That of Fig. 2 is one in which the several parts may be detached and fresh elements substituted therefor.

In Fig. 1, A is a glass tube having a reduced portion at one end and having packed therein charcoal, a drier, and the "hoolamite" in the following fashion: First, there is a small amount of granular pumice B or equivalent material, such as glass wool or

asbestos. This pumice or other material is used for the purpose of retaining the granular charcoal C which is used for the purpose of absorbing other oxidizable gases than carbon monoxid. Next in order in the tube is the layer of drier D which is preferably though not necessarily sulfuric acid absorbed by granules of pumice. In the reduced portion of the tube there is placed the hoolamite in granular form E and the ends of the tube sealed off.

In using the tube of material thus prepared, it is only necessary to break off the tips of the tube and force the suspected gas mixture through the tube and materials in the order above indicated. If the gas contains carbon monoxid, the color of the hoolamite changes in the characteristic manner.

In Fig. 2 the several elements of the detector are made detachable, a form more convenient for some purposes. This form of the detector consists of a small glass tube of the hoolamite H, one end of which may be thrust through the stopper K which fits in the end of the tube F containing the granular active charcoal M. This charcoal is suitably retained in position in the tube by the porous plugs N and the spring L. In the other end of the tube F is inserted the delivery end of the bulb O adapted to force air or other suspected gas through the tube and the materials.

It is to be understood that the invention is not to be limited to the specific examples herein given as it is obvious that these may be varied without departing from the spirit of the invention as defined in the accompanying claims.

Claims:

1. A means for detecting and estimating carbon monoxid in gas mixtures, comprising a layer of active charcoal, a layer of hoolamite, means for passing the gases through the layers in the order named, and means permitting the observation of the change in color of the hoolamite.

2. A means for detecting the presence of oxidizable gases in mixtures of gases, comprising a layer of a drying material and a layer of hoolamite and means for permitting the observation of the color change in the hoolamite.

3. A means for detecting and estimating carbon monoxid in gas mixtures, comprising a glass tube containing a layer of active charcoal and a layer of hoolamite and means for passing the gases through the tube and layers in order named.

4. A means for detecting the presence of oxidizable gases in mixtures of gases, comprising a glass tube containing a layer of drying material and a layer of hoolamite and means for passing the gas mixture through the tube and layers in the order named.

5. Means for detecting the presence of oxidizable gases in gas mixtures, comprising a tubular element wherein are arranged layers of hoolamite, a drier, and a selective absorbent in such fashion as to permit passing the gas mixture therethrough in the reverse of the order named.

6. Means for detecting the presence of carbon monoxid in gas mixtures, comprising a separate container for bodies of granular active charcoal and a drier, means whereby the gas mixture may be passed through the said materials in series, and means containing a body of hoolamite so arranged as to allow the passage therethrough of the gas mixture previously passed through the drier and charcoal.

7. Process of detecting the presence of carbon monoxid in gas mixtures which comprises passing the mixture through an absorbent capable of removing therefrom other oxidizable gases than carbon monoxid and then passing the residual gases through a body of hoolamite, the presence of carbon monoxid being shown by the change of the color of the hoolamite.

8. Process of detecting the presence of oxidizable gases in gas mixtures, which comprises passing the said mixtures through a drier and then through a body of hoolamite, the presence of the oxidizable gases in the mixture being indicated by a change of color of the hoolamite.

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