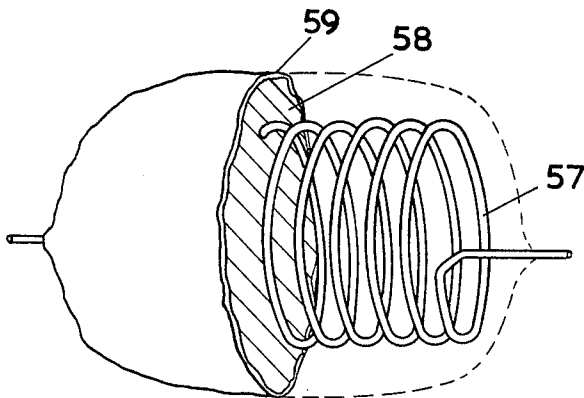


June 4, 1963

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3,092,799

APPARATUS FOR DETECTING COMBUSTIBLE GASES HAVING AN
ELECTRICALLY CONDUCTIVE MEMBER ENVELOPED IN A
REFRACTORY MATERIAL
Filed Feb. 3, 1959



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APPARATUS FOR DETECTING COMBUSTIBLE GASES HAVING AN ELECTRICALLY CONDUCTIVE MEMBER ENVELOPED IN A REFRACTORY MATERIAL

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Filed Feb. 3, 1959, Ser. No. 790,935

Claims priority, application Great Britain Feb. 18, 1958
7 Claims. (Cl. 338—34)

This invention relates to electrically heatable filaments, and more particularly, although not exclusively, to the helical coil type resistance filaments used in connection with the detection of combustible gases in air, for which purpose it is usual to employ a pair of such filaments constituting detecting and compensating elements respectively, arranged in a Wheatstone bridge circuit.

Hitherto the filaments used in this type of apparatus have been exposed directly to the gas sample being tested, the said sample, in the case of a combustible gas being oxidised by catalysis at the metal surface of the detecting filament wire thereby raising the temperature of the latter and therefore its resistance, so that the normal balance of the electrical bridge circuit is upset, and the out-of-balance current passed through an electric meter or any other suitable indicator.

In apparatus of the above type, the detecting filaments are often heated to a temperature of 900° C. or more, depending upon the particular metal of which the filaments are made. At these relatively high temperatures, the metal evaporates from the surface of the filament wire, in consequence of which, the resistance of the filament is continually increasing especially during the oxidation of combustible gases. This continuous increase in resistance, which is greater in the detecting filament than in the compensating filament, causes an increase in the zero reading of the bridge circuit which must therefore be reset at frequent intervals.

The object of the present invention is to provide a filament adapted to be electrically heated and more particularly intended for use in the detection of combustible gases in air, which filament is not only of more robust construction than those used hitherto, but which can be used at lower temperatures so that its resistance is not affected to the same extent by the oxidation, under catalytic action, of high concentrations of combustible gases.

In accordance with the invention, a filament to be electrically heated is embedded in a coating or pellet consisting of an oxide or other refractory materials so as to be enveloped on all sides by a layer of said oxide or other refractory materials.

Referring now to the accompanying drawing, a filament 57, which may be of a metal of the platinum group and in the form of a helically coiled wire, is embedded within or completely surrounded by an oxide or other refractory materials such as alumina or silica, so as to form a coating or pellet 58. The alumina or silica is applied to the filament by the evaporation and decomposition by heat, of a paste or solution of a compound such as a nitrate, hydroxide or alkali silicate. More particularly, the alumina pellet 58 may be formed by the application to the coiled filament 57 of successive layers or portions of a saturated solution of aluminium nitrate in water, and after the application of each layer or portion, heating the layers or portions by passing an electric current through the filament.

When the filaments are to be used in apparatus for the detection of combustible gases in air, such as described, for example, in my co-pending United States application Serial No. 790,870, filed February 3, 1959, a catalyst such as palladium or a mixture of platinum and palladium may

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be added which by impregnation tends to form an outer coating 59 surrounding the oxide pellet 58 of the filament constituting the detecting element, which catalyst may be applied as a solution or dispersion of a compound or compounds of one or more metals of the platinum group. One example of catalyst solution which may be used, is obtained by mixing:

- 1.2 ml. of 8 percent (by weight) of palladous chloride (PdCl_2) in 6 N hydrochloric acid,
- 0.8 ml. of 5 percent (by weight) of Chlorplatinic acid ($\text{H}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$) in water
- 0.2 ml. of 10 percent (by weight) of aluminium nitrate ($\text{Al}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$) in water.

The liquid is removed and the catalyst made active by heating in air, or if necessary, in another gas.

Alternatively the catalyst may be condensed on the pellet 58 by heating either the internal filament 57 embedded in the pellet, or an external filament in close proximity to the pellet, to a temperature above 1000° C. In so far as the compensating filament is concerned, for use at high temperatures, a suitable metallic oxide such as chromium oxide or some other catalyst poison may be added to the material forming the pellet so as to suppress the oxidation of combustible gases.

According to a modification adapted more particularly for use as a detecting element, and having its filament embedded within an oxide or other refractory materials such as alumina or silica coated externally with a catalyst in the manner already described, the pellet 58 is provided with an additional coating of alumina or other refractory materials applied on the top of the external coating of catalyst 59. After heating to approximately 1000° C. for a few minutes, preferably in a combustible gas, enough of the catalyst 59 diffuses through the additional coating to the external surface of the latter. The effect of this coating is to reduce the loss in catalytic activity which occurs when the detecting element is heated for several hours in air or in low concentrations of methane.

When the filaments are to be used in apparatus for the detection of one non-combustible gas in the presence of another or others, or high concentrations of a combustible gas in air such as described, for example, in my co-pending United States application No. 790,870, filed February 3, 1959, two similar filaments may be used. One filament is exposed to the sample of gas to be tested while the other is exposed to a standard or reference gas such as pure air. In this case, the material forming the pellet 58 may be modified by the addition of, for example, a metallic oxide to prevent any type of gaseous reaction so that the temperatures of the filaments 57 are affected only by the thermal conductivity and other physical properties of the gases in contact with the filaments.

Where the embedded filaments, according to the invention, are used in the detection of combustible gases, the latter are not oxidised on the filament wire and the filaments can be operated at a lower temperature than exposed filaments, as a result of which the rate of evaporation of metal from the wire filaments is negligible. The necessity, therefore, to make frequent zero adjustments to the electrical bridge circuit as required by the use of exposed filaments in gas detection apparatus as hitherto employed, no longer arises.

In addition, the operational life of these embedded filaments is considerably longer than is the case with exposed filaments.

I claim:

1. An electrically heatable element comprising a metal filament, a refractory material enveloping said metal filament and a coating of a catalytic material about said refractory material, in which the coating of catalytic material consists of palladium.

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2. An electrically heatable element comprising a metal filament, a refractory material enveloping said metal filament and a coating of a catalytic material about said refractory material, in which the coating of catalytic material consists of a mixture of platinum and palladium.

3. A device for use in apparatus for detecting combustible gases in an atmosphere of the type surrounding said device, the device comprising an electrically conductive member having a given temperature coefficient of resistivity other than zero, an uncovered refractory material intimately enveloping said member on all sides to prevent said atmosphere from reaching any surface of said member, an oxidation controlling substance added to said refractory material and exposed, with said refractory material, to said atmosphere, the arrangement being such that any oxidation of the gases in said atmosphere at the surface of said refractory material exposed thereto generates heat affecting the temperature and therefore the resistance of said electrically-conductive member while the member itself is protected from oxidation by said total refractory envelopment.

4. A device as set forth in claim 3 produced by applying at least one layer of refractory material on said electrically-conductive member, drying said refractory material to form an envelope about all of the surface of said electrically conductive member, applying at least one layer

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of said oxidation-controlling substance to the envelope, applying at least one additional layer of refractory material to the coated refractory material and heating the article to dry the refractory material and to diffuse the oxidation-controlling substance to the outer surface of the device.

5. A device as set forth in claim 3 in which the oxidation-controlling substance is a catalyst which induces the oxidation of combustible gases.

6. A device as set forth in claim 3 in which the oxidation-controlling substance is a catalyst poison which inhibits the oxidation of combustible gases.

7. A device as set forth in claim 3 in which the oxidation-controlling substance is dispersed through the outermost region of the refractory material.

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