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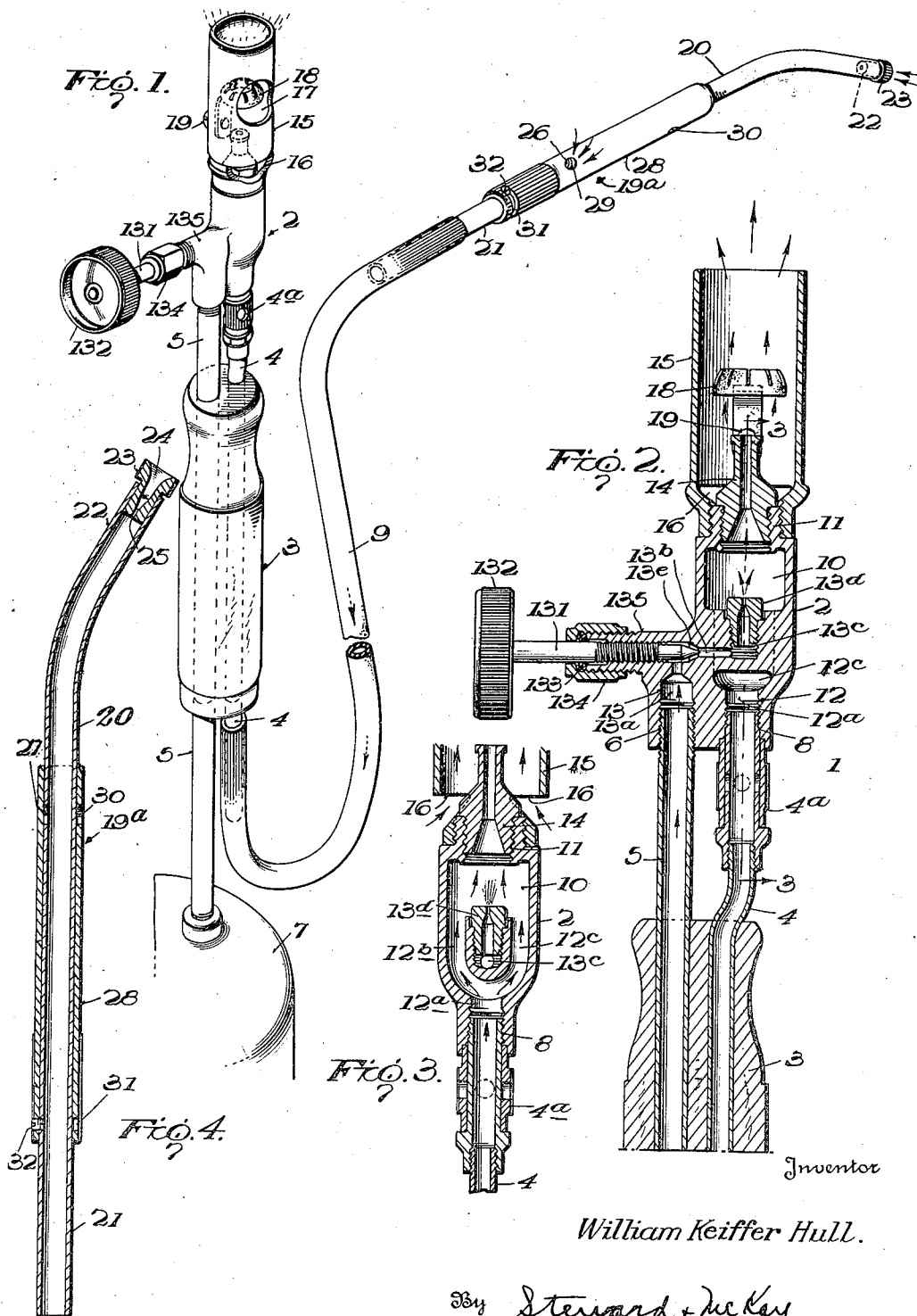
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APPARATUS FOR DETECTING GASES

Filed Aug. 12, 1935

2 Sheets-Sheet 1



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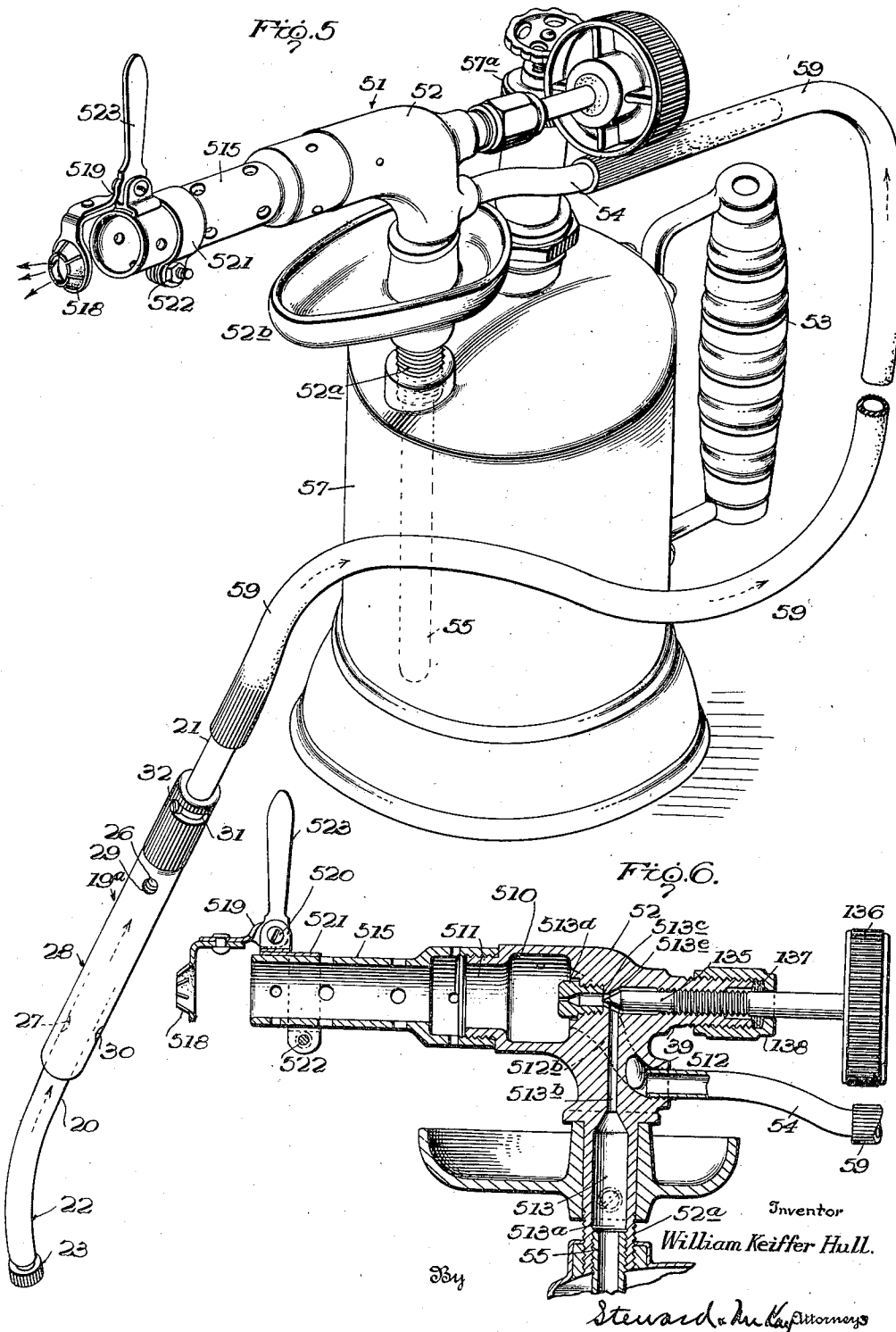
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UNITED STATES PATENT OFFICE

2,106,147

APPARATUS FOR DETECTING GASES

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7 Claims. (Cl. 23-254)

This invention relates generally to apparatus for detecting gases and is concerned more particularly with the detection of gases containing chlorine and/or fluorine.

5 With the rapidly increasing use of dichlorodifluoromethane, methyl chloride, methylene chloride, ethyl chloride, trichloro ethylene and other halide gases as the refrigerant in refrigeration and air conditioning units, the problem of detecting leaks has become of great importance. This problem is complicated because of the fact that these gases are practically odorless, tasteless and colorless and therefore difficult to detect, especially when mixed with comparatively large quantities of air.

10 This invention is particularly adapted for use in detecting even traces of gases of the type just mentioned because of leakage from refrigerating units and the like and therefore, for convenience, this use of the invention will be described, but it is to be understood that the invention is not limited to this particular use.

15 Broadly stated, the general object of the invention is to provide improved apparatus for detecting the presence of gases of the character indicated by means of the characteristic light emitted by suitable reactive material, when heated, in the presence of the gas to be detected.

20 Stated more specifically, one of the principal objects of the invention is to provide, as a simple, light, compact, portable, inexpensive, trouble-proof unit, means for supporting and heating the reactive material under conditions which ensure maximum sensitivity in the detection of the gas to be detected, together with means for automatically creating the maximum amount of suction for bringing the gas to be detected into proximity to or contact with the reactive material.

25 Another object of the invention is to provide novel means for collecting the gas to be detected, usually mixed with air.

30 A further object of the invention is to provide a novel burner which can be easily and conveniently adjustable and controlled and which ensures perfect combustion of the fuel.

35 Other objects and novel features and advantages of the invention will become apparent from the following description taken in conjunction with the following drawings which illustrate two forms of apparatus embodying the invention, it being understood that the description of these specific embodiments is merely illustrative and not restrictive.

In the drawings:

Fig. 1 is a perspective view of one form of apparatus embodying the invention,

Fig. 2 is a longitudinal sectional view taken through the burner head,

Fig. 3 is a sectional view taken on the line 3-3 of Fig. 2,

Fig. 4 is a longitudinal sectional view of the gas collector tube,

Fig. 5 is a perspective view of a modified form of the invention, and

Fig. 6 is a longitudinal sectional view of the modified form.

Referring to the drawings, more particularly Figs. 1-4, 1 indicates generally a torch or burner, suitable for burning gaseous fuel, such as acetylene, butane, or other similar combustion gases. Burner 1 comprises a burner head or body 2 and a handle portion or grip 3 fitted with tubes or conduits 4 and 5 by means of which the handle is connected to the burner head 2. One end of tube 5 is connected by screw threads to a threaded socket or aperture 6 in the burner head and the other end is connected either directly or by means of a hose to a valve-controlled tank 7 or other suitable source of acetylene or similar gas under pressure. When the burner is connected directly to a tank, especially of the light portable type, the latter functions as a base or support for the burner to provide a very convenient portable self-contained unit. One end of pipe or tube 4 is connected by screw threads to a threaded socket or aperture 8 in the burner head 2, the other end of the tube being arranged to receive a flexible hose or gathering tube 9 by means of which air or air mixed with the gases to be detected is supplied to the burner head.

The burner head or casing 2, in the specific structure illustrated by way of example, comprises a casting which is cored or drilled to provide a combined mixing and suction chamber 10 provided at one end with an outlet passage or bore 11 and at the other end with an inlet bore or passage indicated generally by 12, and an inlet bore or passage indicated generally by 13. Outlet passage or bore 11 is provided with screw threads to receive a removable burner tip or nozzle 14. Inlet bore or passage indicated generally by 12 has a portion 12a, connected to socket 8 and pipe 4, which is arranged centrally of and in longitudinal alignment with the outlet bore or passage 11, portion 12a leading into and terminating in two divergent branch passages or bores 12b and 12c which open into the chamber 10 at the end thereof opposite outlet 11.

The other inlet passage or bore indicated generally by 13 comprises a longitudinally extending portion 13a which is connected at one end to the threaded socket 6 and pipe 5, the other end being connected to or opening into a laterally extending portion or bore 13b, one end of which extends between the divergent branch passages 12b and 12c of the other inlet and terminates in a longitudinally extending portion or bore 13c fitted with a threaded removable injector nozzle 13d, the arrangement being such that the injector nozzle 13d is arranged centrally of the chamber 10 and in longitudinal alignment with the outlet passage or bore 11. The portion 13b of the inlet indicated generally by 13 is provided with a conical valve seat 13e to receive a needle valve 13f threaded in an extension of the bore 13b, the valve, provided with the handle 13g, projecting laterally from the burner head or casting. A gas-tight connection about the stem of the needle valve 13f is provided by means of suitable packing 13h and gland nut 13i which is threaded onto a lateral extension 13j of the casing 2.

It will be clear from the particular construction and arrangement just described that, when inlet passage 13, comprising the longitudinally extending portion 13a, the laterally extending portion 13b, the longitudinally extending portion 13c provided with the longitudinally extending injector nozzle 13d, is supplied with acetylene or other suitable combustible gas under pressure by the pipe 5, this gas, passing through the injector nozzle into the chamber 10 at high velocity, will induce or create a high or strong suction and draw air or air mixed with the gas to be detected into said chamber through the inlet passage 12 comprising the portion 12a and the divergent branch passages 12b and 12c; consequently air or air mixed with the gas to be detected will be drawn through pipe or tube 4 and the flexible hose 9 connected thereto. Not only will the injector nozzle 13d create considerable suction in chamber 10, but because of the location and arrangement of the parts just described, a thorough mixing of the gases or gases and air will take place to form a perfectly combined combustible mixture and this mixture will be discharged through the outlet passage 11 and the nozzle or burner tip 14 connected thereto, to be burned. Because of the perfect combustion, a very hot substantially colorless flame will be produced. The fact that the inlet passage 12 extends longitudinally and centrally of the burner head, providing a smooth, substantially unobstructed passage for flow of air or air mixed with gas to be detected, which passage is in substantial alignment with the outlet, and the location of the injector nozzle 13d projecting toward and in longitudinal alignment with the outlet and between the divergent branches 12b and 12c of inlet passage 12 makes it possible to obtain the maximum suction and the thorough mixing which characterize this construction and arrangement of parts.

The valve 13f provides a means for regulating and controlling the flame at the burner, independently of the tank valve, and this is a matter of considerable convenience in actual use. Furthermore, the arrangement of the gas inlet passage just described prevents any flare-back or backfire of the gas beyond the burner head and by introducing the combustible gas under pressure through the comparatively small injector nozzle, the expanding gas has a tendency to cool

the combined suction and mixing chamber and thus prevent overheating of the burner head.

Mounted on the burner head 2, by means of screw threads or similar fastening means, is a tubular portion or shield 15 provided with air inlet openings 16 and an observation window or opening 17. Shield 15 which surrounds the heating or combustion zone of the burner 2 supports the reaction element or member 18 secured by means of a screw, rivet or similar fastening means 19 to the shield 15. Reaction element 18 may consist of copper, nickel, or any other suitable material which reacts with the gas to be detected to form a substance which emits a characteristic light when heated, and may vary in shape, within the broad scope of the invention. In the present instance, reaction element 18 comprises a substantially umbrella-shaped slotted annular frusto-conical body of copper which is supported so that it is heated by the substantially colorless flame provided by the ignited combustible mixture discharged from the burner tip 14 and is visible through the observation opening 17 in shield 15. This flame is ordinarily produced by a combustible mixture of acetylene or other combustible gas and air, but when even mere traces of the halide gas or gases to be detected are introduced through the burner tip or nozzle 14 into proximity to or contact with the heated copper reaction element 18, the flame is immediately colored a brilliant green, and thus a very sensitive positive test for gases of the character indicated is provided.

The shield 15 constitutes an important feature of this invention because upon it depends to a considerable extent the accuracy, reliability and sensitivity of the test. In functioning as a shield, element 15 becomes very hot and therefore it is essential that it be made of a material which is free from any substance which would color the flame. In the present instance, therefore, shield 15 is made from a special grey cast iron which is free from nickel and other elements or compounds which might affect the color of the flame. Such material is not only desirable because it will not color the flame, but it produces a dark background or pocket which makes observation of the flame very easy.

The particular construction and arrangement of the reaction element or member 18, in cooperation with the shield 15, has been found in practice to provide a very sensitive, accurate and reliable test for gases of the character described. The slotted construction and the annular frusto-conical shape of the member 18 makes it possible to expose a maximum surface, which fills a large part of the cross-sectional area of the shield, and thus obtain maximum sensitivity without unduly obstructing the flame or flow of the products of combustion.

Another important feature of the invention resides in the means, indicated generally by 19a, for collecting or gathering the gases to be detected, the arrangement being such that not only is a constant uninterrupted supply of air provided for the burner, but a sample or quantity of gas or gas mixed with air can be collected and temporarily held and not released or passed to the burner for a test until convenient to do so. As illustrated in Figs. 1 and 4, the collecting means 19 comprises a tubular member 20 having an end 21 adapted to receive the inlet end of the flexible tube or hose 9. For convenience, tube 20 is slightly bent intermediate its ends, the end 22 being provided with a removable fitting or nozzle

23 provided with a substantially conical or inclined passage 24 terminating in a restricted opening 25. Fitting 23, with its inclined passage 24 and restricted opening 25, constitutes a restricted inlet opening to receive the gas to be detected, the particular construction and arrangement making it possible to locate with extreme accuracy the source of a leak. As it is usually desirable to provide the burner with more air than can be drawn through the fitting 23, the tube 20 is provided with two longitudinally spaced holes 26 and 27. These holes or air inlet openings are selectively controlled by a tubular valve member 28 rotatably mounted on the tube 20. Holes 26 and 27 in tube 20 are arranged at an angle of substantially 90° to each other and sleeve 28 is also provided with holes 29 and 30 at an angle of substantially 90° to each other, the arrangement being such that in one position of the valve sleeve 28, holes 26 and 29 are in register and holes 27 and 30 are out of register, and in the other position of the sleeve, holes 26 and 29 are out of register and holes 27 and 30 are in register. In order to limit rotation of valve sleeve 28, it is provided adjacent one end with a substantially 180° slot 31 which receives a pin or screw 32 carried by tube 20.

It will be obvious from the foregoing that the air inlet openings 26 and 27, one of which is always open, provide a constant uninterrupted supply of air to the burner, but as previously noted, these holes also function in another and very important way. In using the device to detect a leak, the valve member 28 is arranged so that the holes 26 and 29 are in register and the end of the tube containing the fitting 23 is then placed in close proximity to the suspected leak. Due to the suction of the burner, air is sucked or drawn in through the registering holes 26 and 29 and, if there is a leakage at the point suspected, gas to be detected, usually mixed with air, is drawn in through the opening 25 in fitting 23, the relative sizes of the openings being arranged so that there is always the desired amount of suction through each opening. The tube 20 is held at the point of the suspected leak until at least that portion of the tube between air inlet opening 26 and the gas inlet opening 25 is filled with gas to be detected, usually mixed with air, after which the valve sleeve 28 is moved to close opening 25 and open air inlet opening 27. The air rushing in through this opening rapidly conveys a measured volume or "slug" of gas to be detected, consisting principally of the contents of the tube between openings 26 and 27, to the burner, with the result that a very positive and sensitive test is provided, the gas, when it reaches the flame or heated reaction element 18, causing a very noticeable flare-up of color.

Another important advantage of the construction just described resides in the fact that it is possible to collect a sample or quantity of gas to be tested and hold it for a short interval of time before passing it on to the burner for a test. This is a very desirable feature because it frequently happens that it is impossible or inconvenient for the operator to carry the burner with him or have it where he can readily see it. In such a case, the operator first collects a sample of gas to be detected in the tube 20, with inlets 25 and 26 open, and then moves or turns so that he can see the burner, the gas to be detected or tested being held or trapped in the tube between openings 25 and 26. Valve sleeve 28 is then rotated to open air inlet 27 and close

inlet 26 and a measured volume or "slug" of gas is then rapidly passed to the burner for a test, as previously described.

Figs. 5 and 6 illustrate a modified form of the invention which is broadly similar to that illustrated in Figs. 1 to 4, but in this case the invention is embodied in a burner or blow torch adapted to use liquid fuel. Except for certain distinctions which will be pointed out, the description of Figs. 1 to 4 inclusive applies generally also to Figs. 5 and 6 and therefore the construction illustrated in these latter figures will merely be briefly described.

Referring to Figs. 5 and 6, 51 indicates generally a torch or burner, suitable for burning alcohol or any other liquid fuel capable of producing a substantially colorless flame. Burner or torch 51 comprises a burner head or body 52 provided with a threaded portion 52a by means of which it is secured to a tank 57 provided with a handle 53 and a pump 57a for providing pressure in the tank. Burner head 52 is provided with the usual cup 52b to receive liquid fuel which is burned to heat up the burner when first starting. Burner head 52 is provided with tubes or pipes 54 and 55, the latter extending down into the liquid fuel to supply the same to the burner and tube 54 is arranged to receive a flexible hose or gathering tube 59 by means of which air or air mixed with the gases to be detected is supplied to the burner head.

The burner head or casing 52 comprises, in the specific example illustrated, a casting which is cored or drilled to provide a combined mixing and suction chamber 510 provided at one end with an outlet passage or bore 511 and at the other end with an inlet bore or passage indicated generally by 512, and an inlet bore or passage indicated generally by 513. One end of inlet bore or passage 512 is connected to pipe 54, the other end leading into and terminating in two divergent branch passages or bores 512b and 512c, only one of which is shown in Fig. 6, said branch passages opening into the chamber 510 at the end thereof opposite outlet 511.

The other inlet passage or bore indicated generally by 513 comprises a portion 513a which is connected at one end to the pipe 55, the other end having a reduced portion 513b which terminates in a longitudinally extending portion or bore 513c fitted with a threaded removable injector nozzle 513d, the arrangement being such that the injector nozzle 513d is arranged centrally of the chamber 510 and in longitudinal alignment with the outlet passage or bore 511 and between divergent branch passages or bores 512b and 512c of the other inlet. The portion 513c of the inlet indicated generally by 513 is provided with a conical valve seat 513e to receive a needle valve 135 threaded in bore 513c and provided with a handle 136, projecting from the burner head or casing. A gas-tight connection about the stem of the needle valve 135 is provided by means of suitable packing 137 and gland unit 138 which is threaded onto a lateral extension 139 of the casing 52.

It will be clear from the foregoing description that, when inlet passage 513 of burner head or casing 52 is provided with liquid fuel under pressure through the pipe 55, the burner head first having been heated in the usual way, the liquid fuel will be vaporized or gasified as it passes through the portion 513a, the restricted portion 513b and the portion 513c and will be discharged under pressure through the injector nozzle 513d

and will thus induce or create a high or strong suction which will draw air or air mixed with the gas to be detected into chamber 510 through the inlet passage 512 including the divergent branch passages 512b and 512c; consequently air or air mixed with the gas to be detected will be drawn through pipe or tube 54 and the flexible hose 59 connected thereto. A thorough mixing of the gasified fuel and air or air mixed with the gas to be detected will also take place, the combustible mixture being discharged through the outlet passage 511 and burned within the tubular portion or shield 515 which is detachably connected to the burner head or casing 52.

15 The reaction element or member 518 is similar to the reaction element described in connection with Figs. 1 to 4, but in this case, this element is mounted so that it may be moved out of the heating zone or flame of the burner. The means for movably supporting reaction element 518 may differ widely within the scope of the invention, but in the example illustrated this member is secured to a bell crank lever or member 519 pivotally connected at 520 to a ring 521 which is clamped by means of screw bolt 522 to the shield 515, the member 519 being provided with a handle 523 by means of which the members 518 and 519 can be moved to shift the member 518 into and out of position in the heating zone of the burner head. This movable mounting of the reaction element 518 constitutes an important specific feature of the invention because it permits the reaction element or member 518 to be moved to inoperative position when it is desired to test the burner to see whether there is any substance or material causing coloration of the flame, other than the reaction element itself.

The shield 515 is preferably made of a special grey cast iron, free from any substance which would color the flame, as in the case of shield 15 described in connection with Figs. 1-4 and the means for collecting the gas or gases to be detected, with or without air, is as explained in connection with said figures. The general operation and advantages of the modification illustrated in Figs. 5 and 6 are similar to those set out in connection with Figs 1-4.

It will be observed from the foregoing discussion of the invention that both forms provide a compact, simple, portable, inexpensive, trouble-proof unit or combination which will provide a quick positive and accurate test for gases of the type indicated and which will clear up quickly after each test. As an indication of the sensitivity and of the superior suction created, tests show that apparatus embodying this invention is sensitive to and will indicate leaks of as low as 0.06 pound of gas per month and that a suction of better than $\frac{1}{2}$ inch is attainable.

Although the burners disclosed are designed for use in connection with the detection of gases, they are capable of general use as brazing torches, blowpipes, etc., merely by removing the reaction element or moving it out of the flame or heating zone and in some cases removing the shield. When used as a blow-torch, the rubber hose is preferably removed. Many different burner tips can be used and an additional valve controlled air inlet 4a is provided in the form illustrated in Figs. 1-4 for use when the device is used as a torch.

It is to be understood that the invention is not limited to the exact arrangements shown and described and that various changes may be made without departing from the spirit and scope of

the broad invention as defined in the appended claims.

What is claimed is:

1. Apparatus for detecting gases, comprising a burner, including a tubular flame-shielding portion surrounding the combustion zone of said burner and formed from iron free from reactive flame-coloring material, a copper reaction element carried by said tubular portion and supported in the heating zone of said burner, said element reacting with the gas to be detected to form a substance which emits a characteristic light when heated, said element comprising a slotted annular frusto-conical body, and means for bringing the gas into contact with said member including a flexible conduit, and a tubular member connected thereto and provided at one end with a restricted inlet opening for gas to be detected and provided with at least two relatively large longitudinally spaced air inlet openings means for opening and closing said air inlet openings.

2. Apparatus for detecting gases comprising, in combination, a member which reacts with the gas to be detected to form a substance which emits a characteristic light when heated, means for heating said member including means for creating suction, and means for conveying the gas to said member, said last-mentioned means including means providing an inlet opening for air mixed with the gas to be detected and a plurality of longitudinally-spaced openings for air between said first inlet opening and said member and means for controlling said air inlet openings.

3. Apparatus for detecting gases comprising, in combination, a member which reacts with the gas to be detected to form a substance which emits a characteristic light when heated, means for heating said member including means for creating suction, and means for conveying the gas to said member, said last-mentioned means including means providing a restricted opening for air mixed with the gas to be detected and at least two relatively large longitudinally spaced air inlet openings between said first inlet opening and said member, and means operable to simultaneously open one air inlet and close the other and vice versa for controlling said air inlet openings.

4. Apparatus for detecting gases comprising, in combination, a member which reacts with the gas to be detected to form a substance which emits a light when heated, means for heating said member including means for creating suction, and means for conveying the gas to said member including a tube provided at one end with a restricted inlet opening for the gas to be detected, said tube being provided with at least two longitudinally-spaced air inlet openings, and a rotatable sleeve mounted on said tube and operable to open one of said air inlet openings and close the other.

5. Apparatus for detecting gases, comprising a burner, including a tubular flame-shielding portion surrounding the combustion zone of said burner and formed from a material free from reactive flame-coloring material, a reaction element carried by said tubular portion and supported in the heating zone of said burner, said element reacting with the gas to be detected to form a substance which emits a characteristic light when heated, and means for bringing the gas to be detected into contact with said member including a tubular member provided at one end with a restricted inlet opening for gas to be

detected and provided with at least two relatively large longitudinally spaced air inlet openings and means for opening and closing said air inlet openings.

- 5 6. Apparatus for detecting gases, comprising a burner, including a tubular flame-shielding portion surrounding the combustion zone of said burner and formed from material free from reactive flame-coloring material, a reaction element carried by said tubular portion and supported in the heating zone of said burner, said element reacting with the gas to be detected to form a substance which emits a characteristic light when heated, said burner having a combined mixing and suction chamber, an outlet at one end of said chamber and a plurality of inlets at the other end of said chamber, one of said inlets being arranged to provide a passage terminating in diverging branch passages opening into said chamber and the other inlet being provided with an injector nozzle mounted adjacent the divergent branch passages of the first inlet and arranged to deliver combustible gas under pressure to said chamber and draw air through said first inlet into said chamber and deliver a combustible mixture through said outlet, and means to deliver air mixed with gas to be detected to said first inlet, said means including a tubular member provided at one end with
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and provided with at least two relatively large longitudinally spaced air inlet openings and means for opening and closing said air inlet openings.

7. Apparatus for detecting gases comprising, in combination, a member which reacts with the gas to be detected to form a substance which emits a characteristic light when heated, a burner for heating said member, said burner having a combined mixing and suction chamber, an outlet at one end of said chamber and a plurality of inlets at the other end of said chamber, one of said inlets being arranged to provide a passage terminating in diverging branch passages opening into said chamber and the other inlet being provided with an injector nozzle mounted adjacent the divergent branch passages of the first inlet and arranged to deliver combustible gas under pressure to said chamber and draw air through said first inlet into said chamber and deliver a combustible mixture through said outlet, and means to deliver air mixed with gas to be detected to said first inlet, said last-mentioned means including means providing an inlet opening for air mixed with the gas to be detected and a plurality of longitudinally spaced openings for air between said first inlet opening and said member and means for controlling said air inlet openings.

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