Sept. 5, 1944. F. W. DWYER 2,357,638

GAS INDICATOR

Filed March 1, 1940

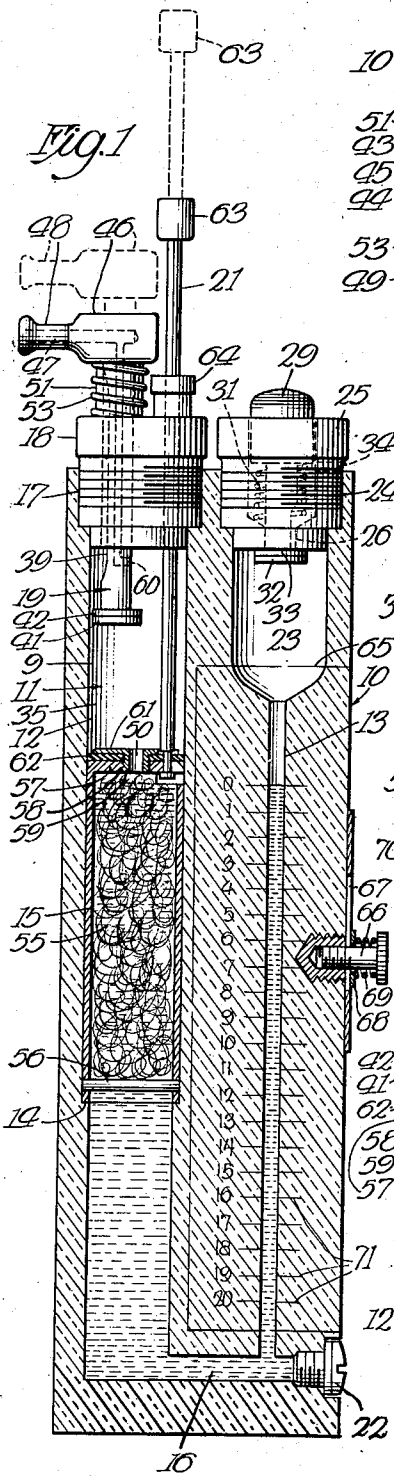


Fig. 1

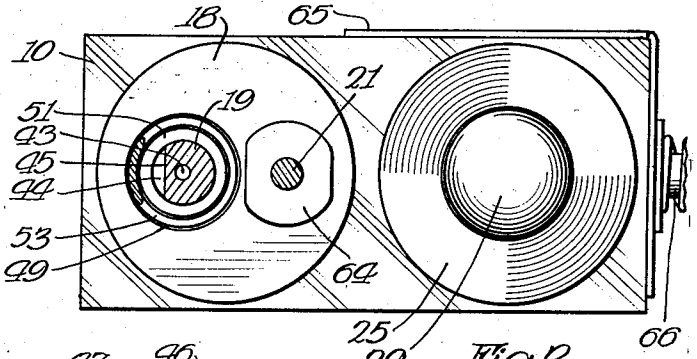


Fig. 3

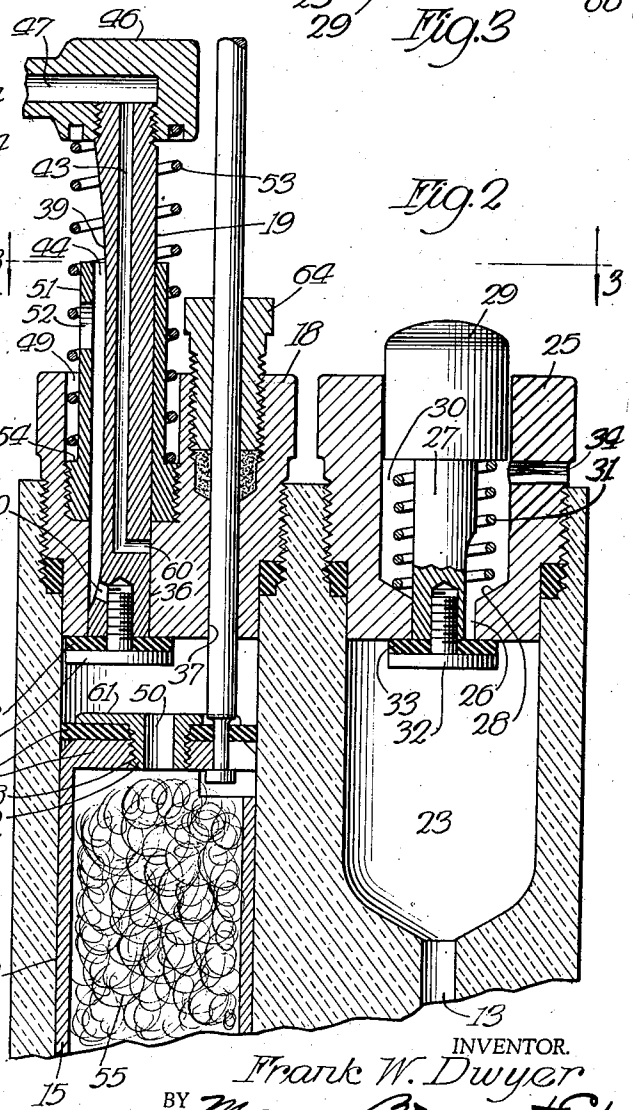


Fig. 2

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Patented Sept. 5, 1944 2,357,638

UNITED STATES PATENT OFFICE

2,357,638

GAS INDICATOR

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Application March 1, 1940, Serial No. 321,739

9 Claims. (Cl. 23—254)

This invention relates to gas indicators and more particularly to apparatuses for indicating the amount of carbon dioxide (CO_2) gas in the products of combustion in furnaces, in the exhaust of engines, and the like.

The principal object of the invention is the provision of a new and improved device for indicating the percentage of CO_2 gas in specimens of smoke, engine exhaust, and the like, and that is small enough to be carried in the pocket and that is substantially accurate.

A further object of the invention is the provision of a pressure operated CO_2 testing device so constructed that whether the device is in operation or not there is no danger of spilling the liquid in the event the apparatus is tipped over.

A still further object of the invention is the provision of a new and improved apparatus for indicating the percentage of CO_2 in a given quantity of mixed gases.

Another object of the invention is the provision of a new and improved apparatus for indicating the amount of CO_2 present in smoke, engine exhaust and the like in which a caustic solution is employed, not only as the absorbing medium for the CO_2 gas but also as the gauge or indicating liquid.

A further object of the invention is the provision of a CO_2 indicating device that is simple in construction, efficient, and substantially accurate in use, that is easily manipulated, and that is not likely to become broken or get out of order.

Other and further objects and advantages of the invention will appear from the following description, taken in connection with the accompanying drawing, in which—

Fig. 1 is a vertical section of the device;

Fig. 2 is a section similar to Fig. 1 of the upper portion of the device showing the same on an enlarged scale; and

Fig. 3 is a section on the line 3—3 of Fig. 2.

Referring now to the drawing, the reference character 10 designates a block of material which may be of a single piece or sectional, as desired. The block has two columns therein intercommunicating at their lower ends. As shown, these columns are in the form of a U-shaped bore 11 having an arm 12 and an arm 13. The arm 12 is of very much larger diameter than the arm 13. The block 10 is preferably, though not necessarily, transparent and in the form of the construction shown, is made or molded from transparent plastic material.

The bore 11 has its intermediate portion 9 of slightly larger diameter than the lower end to provide an annular shoulder 14 for limiting the downward movement of a plunger 15 slidably mounted, as will presently appear.

The lower ends of the arms 12 and 13 are connected by a transverse bore 16. The arm 12 of the bore 11 may be made by first drilling the block from its upper end with a drill having a diameter of the lower end of the arm 12, then counterboring with a larger diameter drill and afterwards further counterboring the outer or upper end of the counterbore to form a section of the bore of further increased diameter, as shown at 17. The inner surface of the counterbore 17 is threaded for receiving a threaded plug 18 in which is adapted to be mounted a combined intake and discharge valve 19 and an operating stem 21 for the plunger 15. The cross bore 16 is formed by drilling from the side, counterboring the outer end of the cross bore and threading the same for receiving a threaded stud 22 for closing the cross bore 16.

The arm 13 is of very small diameter and the bore is counterbored to form a reservoir or chamber 23 of large diameter, as is shown in Figs. 1 and 2. The outer end of the chamber 23 is counterbored and the inner surface threaded as at 24 for receiving a screw threaded plug 25. The plug 25 has an axial opening as at 26 through which a valve stem 27 is adapted to slide. The opening 26 is enlarged, that is, it is counterbored at its upper end as at 30 for forming an annular shoulder as shown at 28. The enlarged bore 23 constitutes an air reservoir under atmospheric pressure for forcing the liquid in the arm 13 of the L-shape bores when the caustic reacts on the CO_2 within the chamber 35, as will presently appear.

The valve stem 27 is provided with a knob or push button 29 at its upper end and a spring 31 is interposed between the shoulder 28 and the knob 29 for normally holding the stem in its uppermost position. Attached to the lower end of the valve stem 27 is a valve or valve head 32 and interposed between the valve head 32 and the lower end of the stem is a sealing washer 33 of suitable material not affected by the liquid employed in the U-bore and which is adapted to seat against the lower end of the plug 25 for closing the opening 26, as shown more clearly in Fig. 2 of the drawing. A passage 34 extending between the enlarged opening 30 and the exterior of the block 10 is provided for the passage of air therethrough when the valves 19 and 32 are open for equalizing the pressure on the two arms of the U-shaped bore 11.

In determining the amount of CO_2 in the combustion gases, it is necessary to provide means whereby the gas to be tested will displace all of the air in a chamber 35 formed between the upper end of the plunger 15 and the lower end of the plug 18 before the combustion gases are exposed to the action of the absorbent liquid. The mechanism for introducing the combustion gases and for permitting the escape of the air from the chamber 35 will now be described.

The valve 19 having the valve stem 39 slidably mounted in the opening or bore 36 in the plug 18 is provided for the admission and discharge of the gas to be tested. A valve head 41, Fig. 2, has an upper reduced screw threaded portion that engages a threaded opening in the valve stem for attaching the head to the stem. The stem is provided with an opening 70 in which a tool may be inserted for jamming the threads of the valve head to prevent accidental loosening of the valve head. A washer 42, of suitable material, forming a seal, is interposed between the head 41 and the lower end of the plug 18 for engaging the plug for closing the opening 36. The valve stem 39 is provided with an intake passage which comprises a bore 43 extending through the upper portion of the valve stem and downwardly to a point adjacent to the valve head but spaced above the same where it turns laterally and terminates at the surface of the stem at 60, as clearly shown on the drawing.

The valve stem is also provided on one side, preferably opposite the opening 60, with a discharge passage 44 which may be formed by a cutaway portion on the side of the valve, as shown at 45 in Fig. 3. Gas is adapted to enter the chamber above the plunger through the opening 60 and air or the gas is adapted to be discharged through the passage 44. The upper end of the valve stem 39 is screw threaded and a fitting 46 is attached thereto. The fitting has a bore 47 which is in communication with the bore 43 of the stem. It is also provided with a nipple 48 by means of which it may be attached to a rubber hose which constitutes a discharge of a small pump, not shown, the intake of which is adapted to be placed in the stack for obtaining a sample gas to be tested, as is usual in such constructions.

Appropriate means are provided for holding the valve in its closed position. Any suitable means may be employed for this purpose. In the form of the invention shown, the plug 18 is counterbored as at 49 and is screw threaded at its lower end for receiving the threaded end of a sleeve 51. The sleeve 51 may, if desired, be provided with an opening 52 in its side wall opposite the passage 44 through which air displaced in the chamber 35 may escape. A spring 53 is adapted to seat on a shoulder 54 formed on the lower end of the sleeve 51 and has its opposite end engaging the fitting 46 for normally holding the stem in its uppermost position so as to close the valve 41.

Suitable means are provided for separating the absorbent liquid from the gas to be tested during the process of injecting a sample of the gas into the chamber 35 and for mixing the gas with the absorbent liquid after the same has been trapped. In the form of the construction shown, the plunger 15 is cylindrical and closely fits the intermediate section of the arm 12 of the bore, as shown in Figs. 1 and 2, and has a closed upper end and an open lower end. The plunger is adapted to be filled with porous or fibrous material, such as metallic or mineral wool 55, or the like, that is not affected by the caustic liquid, for increasing the surface so as to increase the exposure of the liquid to the gas. The wool is held in position in the head by a pin 56, or the like, extending across the lower end of the plunger.

The upper end 57 of the plunger 15 has a central threaded opening 58 of small diameter within which is threaded a downwardly extending stud 59 of a plate member 61 which has an axial opening 50 of small bore. The diameter of the bore or opening 50 is small so that there will be little or no movement of gas downward through the opening while the plunger is at rest. It is large enough, however, for the gas to pass through when the plunger is elevated.

Interposed between the plate member 61 and the end 57 of the plunger 15 is a wiper 62, of suitable material not affected by the gas or caustic liquid, which is clamped in position by the plate member 61. The wiper is adapted to clean the walls of the chamber 35 when the plunger is raised and lowered by the stem 21 extending through the plate and wiper and secured to the upper end of the plunger. Without this wiper, more or less of the caustic will adhere to the walls after a test has been made to seriously affect a following test. In other words, the reaction of this residue on the incoming gas will seriously interfere with obtaining a pure sample of the gas to be tested.

The stem 21 extends upwardly through an opening 37 in the plug 18 and terminates in a knob 63, or the like, for convenience in manipulating the stem 21. A suitable gland 64 is provided for sealing the opening 37 against the escape of gas along said stem.

A suitable scale is provided on the block 10 for indicating the percentage of CO_2 in a sample of gas tested. The scale may be read through the block. The scale may be printed or engraved directly on the block but, preferably, a separate indicator plate 65 is provided for this purpose. It is L-shaped in cross-section, as shown in Fig. 3, and is attached to the block by means of a set screw 66, Fig. 1, which extends through a slot 67 in the plate and is threaded into the block 10. A washer 68 frictionally engages the outer edge of the indicator plate 65 and a spring 69 is provided between the head of the set screw and the washer 68 for causing the washer 68 to frictionally hold the plate in vertically adjusted position. The indicator plate 65 is provided with a scale 71; that is, it is calibrated so that the percentages may be read directly from the scale.

The testing liquid, which is caustic soda (NaOH) or potash (KOH) if CO_2 is to be tested, is introduced into the instrument by removing the plug 25 and pouring the caustic solution into the receptacle 23 while holding the valve 19 in lowered position. Sufficient liquid is introduced to bring the level thereof in the columns to a level just below the upper end wall 57 of the plunger but of sufficient distance from the upper end of the plunger to compensate for the rise of the column of caustic so that during tests none of the liquid will pass through the opening 50.

In the operation of the device, the two valves 19 and 32 are first pressed down for opening the same for placing the two columns in communication with the air for equalizing the pressure therein. The two valves may then be released.

After the flexible tube for conducting the gas to the instrument has been attached to the nip-

ple 48 and proper connections made, the valve 19 is lowered by pushing downwardly on the fitting 46 against the compression of the spring 53 and the pump is operated for introducing the gas through the conduit 43 into the chamber 35. The gas passes into the chamber through the passage 43 and the air and gas pass out of the chamber 35 through the passage 44.

After the gas has been running through the chamber for some time so as to be sure to displace all of the air, the valve 19 is released for closing the passages 43 and 44 for entrapping a sample of the gas. Due to the small diameter of the passage in the threaded extension of the plate 61, the reading will not be affected. The operator will now raise and lower the plunger 14 by pulling upwardly and pushing downwardly on the knob 63 which will thoroughly mix the gas to be tested with the liquid. When the plunger is elevated, the gas will be forced through the passage 50 down into the wool where it is brought into intimate contact with the caustic. When the plunger is depressed, the caustic is forced upwardly into the wool for wetting the same. The reciprocation of the plunger is continued until the liquid in the arm 13 becomes stationary when the plunger is seated on the shoulder 14.

The reaction of the caustic on the CO_2 of the gas will lower the pressure within the chamber 35 and cause the pressure of the air in the chamber 23 to force the liquid downwardly in the small bore 13 where the percentage may be read directly from the scale. In order to facilitate reading of the scale, the liquid may be colored by aniline dye or the like. The lowering of the plunger 15 will cause the wiper 62 to wipe the walls of the chamber 35 so that the chamber will be in condition for receiving the next charge.

While the members 12 and 13 are described as arms of a U-shaped bore, they may be regarded as two columns or receptacles connected together by a transverse bore 16 which places the two receptacles in communication with each other.

It is thought from the foregoing, taken in connection with the accompanying drawing, that the construction and operation of my device will be apparent to those skilled in the art and that changes in size, shape, proportion and detail may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. A gas indicator comprising primary and secondary upstanding receptacles having their lower ends connected together by a passage and being adapted to be partially filled with a liquid that will chemically combine with the gas to be tested, a closure for the primary receptacle having a downwardly opening valve, means for automatically seating said valve whereby the gas to be tested may be simultaneously introduced into said primary receptacle and discharged therefrom when the valve is open, and apertured solid means in said primary receptacle normally separating said gas and liquid and movable to cause intermingling of said gas and liquid.

2. In a gas indicator device, a transparent block of material having a U-shaped bore therein adapted to contain a caustic solution extending upwardly into both arms thereof, a hollow plunger open at its lower end and filled with mineral wool within one arm of said U-shaped bore, means including a knob on the plunger for raising or lowering said plunger into and out of the surface of the liquid in the said one of said arms, a washer carried by said plunger and frictionally engaging the walls of the surrounding bore, said plunger and washer having alined axial openings of small caliber, valve means through which a gas may enter or be discharged from the space within said bore above said plunger, and a graduated scale carried by said block and positioned opposite the other bore for indicating the level of said solution therein.

3. An apparatus for indicating the amount of a particular gas constituent in a gas sample, comprising a block of material having a U-shaped bore therein adapted to be partially filled with a liquid that will react on said gas constituent, one arm of said bore being of greater diameter than the other, means for introducing the gas to be indicated into the arm of larger diameter above said liquid and for discharging the air from said last-named arm, movable means for selectively separating said gas and liquid and for intermingling said gas sample and liquid, said means including a plunger within said arm of greater diameter and frictionally engaging the walls of said last-named arm for preventing accumulation of solid matter thereon, said plunger being hollow and open at its lower end, the upper end of said plunger being of solid material and having a small aperture through which the gas to be tested may pass during the testing operation, spongelike material in the hollow of said plunger, and means carried by said block adjacent the smaller bore for indicating the percentage of the particular gas in said sample.

4. An apparatus for indicating the amount of a particular gas constituent in a gas sample comprising a block of material having a U-shaped bore therein adapted to be partially filled with a liquid that will react on said gas constituent, a passage for conducting a gas to be tested to one arm of said bore and a passage for discharging the air contained in said one arm, a single slidable valve for opening and closing said passages, movable, means including a plate for normally separating said gas and liquid and for bringing said gas and liquid in intimate contact, said plate having an aperture for the passage of the gas to be tested, said means frictionally engaging the interior of the walls of said one arm, and a scale carried by said block for indicating the height of the liquid in the other of said arms.

5. A gas indicator comprising a block of transparent material having a U-shaped bore therein adapted to contain a caustic liquid partially filling both arms of said U-shaped bore, means slidable in said block for entrapping a sample of combustion gas in the upper portion of one arm of said bore, slidable means in said one arm including an apertured solid member for normally separating said gas and liquid and also including a hollow plunger having means for intermingling said liquid with said gas, and a scale mounted on said block for indicating the percentage of CO_2 gas in said sample by comparing the level of the depressed liquid in said other arm of said bore with its original level.

6. A small portable gas testing device comprising a block of transparent material provided with a U-shaped bore for containing a caustic liquid, means including a single sliding valve for admitting gas into and permitting discharge of the displaced air from one arm of said bore, means in said one arm comprising a plunger having an upper closed end and an open bottom and containing means to intermingle said gas and liquid when the plunger is operated, a wiper carried by said plunger for frictionally engaging

the interior surface of the walls of said one arm, said plunger having a small passage through its upper closed end through which the gas to be tested is adapted to pass, said plunger constituting means for separating the gas and liquid prior to the operation of said plunger, and means comprising a scale carried by said block for indicating the amount of gas absorbed by said liquid.

7. In a portable gas tester, a pair of receptacles for containing a caustic liquid, a passage below the level of said liquid for interconnecting said receptacles, means including slidable valve mechanism for trapping a sample of combustion gas in one receptacle above said liquid, slidable means in said one receptacle for normally separating said gas and liquid in said last named receptacle, said slidable means including a wiper for cleaning the walls of said last named receptacle and including also a hollow plunger having a closed upper end and containing finely divided material adapted to be submerged in said liquid, said closed end being apertured for admitting gas to intermingle with liquid carried by said finely divided material, and a scale associated with the other receptacle for indicating the amount of said gas absorbed by said liquid.

8. In a gas indicator, a U-shaped receptacle having its arms extending upwardly, a plunger in one of said arms, said receptacle being reduced in diameter in the lower portion of the other of said arms, a shoulder for limiting the downward movement of said plunger in said one arm, said plunger being hollow and having an upper closed end with a small aperture therethrough, fibrous material in said plunger, a wiper secured to the closed end of said plunger and having a small aperture therethrough in alinement with said small aperture in the plunger, said wiper frictionally engaging the walls of said one arm, said aperture being just large enough to let the gas through when the plunger is raised but small enough to prevent any substantial passage otherwise, said receptacle being adapted to contain a caustic liquid having its surface adjacent to the plane of said closed end when said plunger is seated on said shoulder, means for equalizing the air pressure in both of said arms in the space above said liquid and for trapping a sample of combustion gas in the space above said plunger, handle means connected to said plunger for raising and lowering said plunger for intermingling said gas and liquid, and a scale opposite the liquid in the other of said arms for indicating the height of the liquid therein.

9. A gas testing apparatus comprising a block having a U-shaped bore therein, said bore having one arm of enlarged diameter and its other arm of greatly restricted diameter at its lower end and being adapted to contain a caustic solution partially filling said bore, plugs in the upper ends of said arms, an intake and an exhaust port in one of said plugs, slidable valve means for opening and closing said ports, a plunger in the arm of the bore of enlarged diameter, said plunger having an opening extending longitudinally thereof, the upper portion of said opening being just large enough to let the gas through when the plunger is raised but small enough to prevent any substantial passage otherwise, an apertured wiper carried by said plunger for cleaning the walls of said bore above said plunger, and a scale mounted on said apparatus for indicating the amount of said gas absorbed by said liquid during a test.

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