A. BUTCHER.

CARBON DIOXID ANALYZER.

APPLICATION FILED MAR. 22, 1917.

1,285,927.

Patented Nov. 26, 1918.

2 SHEETS—SHEET 1.

Fig. 2.

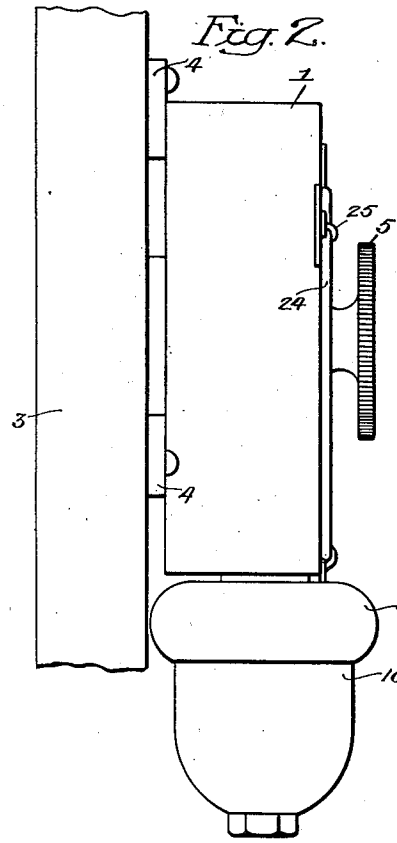


Fig. 1.

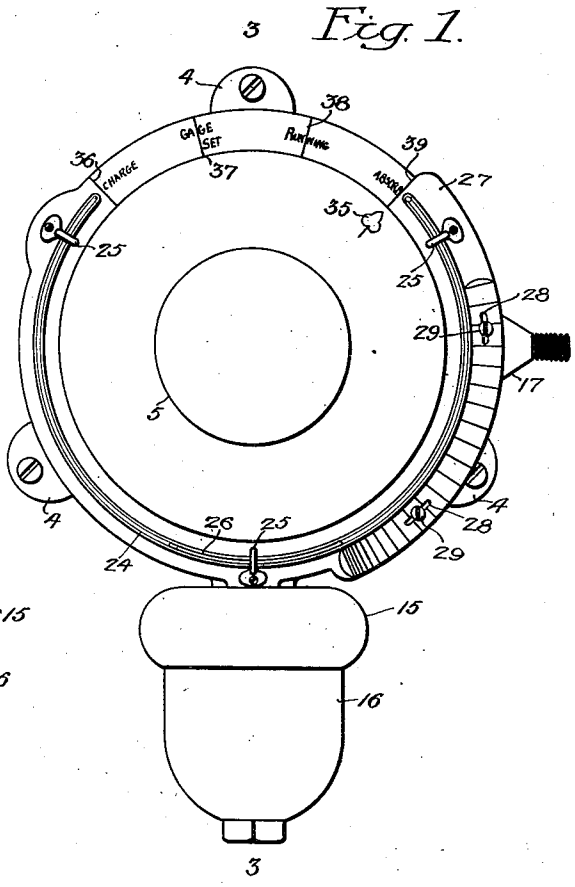


Fig. 6.

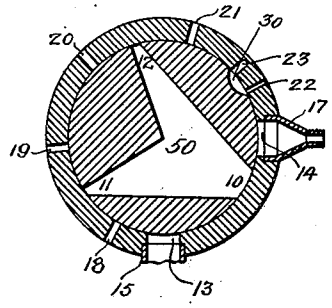
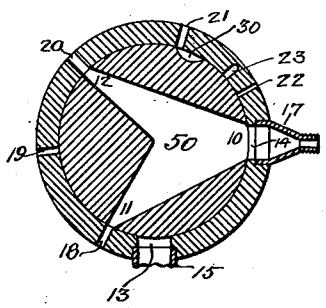


Fig. 5.



Inventor
Alfred Butcher
by his Attorneys.
Howson & Howson

A. BUTCHER.

CARBON DIOXID ANALYZER.

APPLICATION FILED MAR. 22, 1917.

1,285,927.

Patented Nov. 26, 1918.

2 SHEETS—SHEET 2.

Fig. 3.

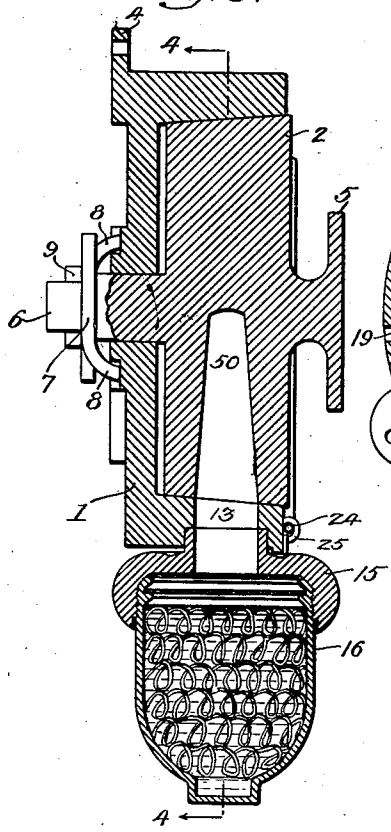


Fig. 4.

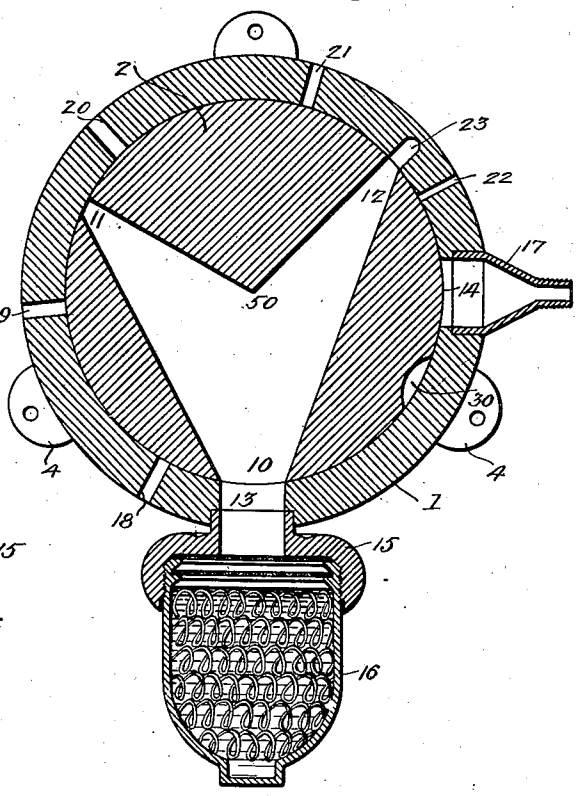
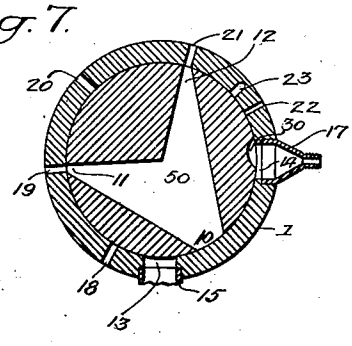


Fig. 7.



Inventor
Alfred Butcher
by his Attorneys.
Howson & Howson

UNITED STATES PATENT OFFICE.

ALFRED BUTCHER, OF PHILADELPHIA, PENNSYLVANIA.

CARBON-DIOXID ANALYZER.

1,285,927. Specification of Letters Patent. Patented Nov. 26, 1918.

Application filed March 22, 1917. Serial No. 156,749.

To all whom it may concern:

Be it known that I, ALFRED BUTCHER, a subject of the King of Great Britain and Ireland and the Isle of Man, (having declared my intention of becoming a citizen of the United States,) residing in Philadelphia, Pennsylvania, have invented Carbon-Dioxid Analyzers, of which the following is a specification.

One object of my invention is to provide a simple, inexpensive, substantial and conveniently operated device whereby it shall be possible to quickly ascertain the percentage of carbon dioxid or other gaseous substance in a body of gas; the arrangement of parts being such as to permit of the successful operation of the apparatus by an unskilled person.

Another object of the invention is to provide a simple, easily manipulated device particularly adapted for use in connection with internal combustion engines especially of the type employed on motor vehicles, whereby the products of combustion as found in the exhaust may be easily and conveniently analyzed in order to determine when the engine is being operated with the proper proportions of air and fuel.

These objects and other advantageous ends I secure as hereinafter set forth, reference being had to the accompanying drawings, in which:

Figures 1 and 2 are respectively a front and a side elevation of a carbon dioxid analyzer constructed according to my invention;

Fig. 3 is a vertical section on the line 3—3, Fig. 1;

Fig. 4 is a vertical section on the line 4—4, Fig. 3; and

Figs. 5, 6 and 7 are diagrammatic vertical sections of the body of the apparatus drawn on a reduced scale, illustrating the movable member or plug in certain of its adjusted positions.

In the above drawings 1 represents a flat, open faced casing having in the present instance a cylindrical outline and formed with a slightly tapering cavity for the reception of a correspondingly tapered rotary plug 2,—there being projecting lugs or feet 4 designed for the reception of screws or the like whereby said casing may be held to a vertical supporting structure 3. The plug has projecting from the center of its front face a milled operating head or handle 5 and includes a rearwardly projecting stud or spindle 6 extending through a suitable opening in the rear of the casing 1 for the reception of a spring washer 7. This latter is provided with two or more tongues 8 projecting toward the adjacent face of the casing structure 1 which is formed with an annular series of radial teeth or recesses for said tongues, the washer being held to the stud 6 by a cotter pin 9 so as to at all times draw the plug 2 into the cavity of the casing 1.

The body of the plug has formed in it a chamber 50 in the form of a Y-shaped or three-branched passage having ports 10, 11, and 12, opening on its tapering surface, the first of said ports being materially wider than the other two and particularly designed to coöperate or register with either of two similar ports 13 and 14 in the side of the casing structure. These latter ports are preferably arranged 90° distant from each other, while the ports in the plug are approximately 120° apart. The casing port 13 has brazed or otherwise fixed in it a cap 15 which is threaded for the reception of a cup 16 designed to hold the absorbing material which preferably consists of a body of caustic potash in liquid form which is prevented from splashing by a mass of steel turnings or other inert material which preferably fills said cup.

The upper portion of the cup 16 is preferably formed with an annular recess for the reception of a circular screen 17 of metallic netting or fine gauze of suitable material and the liquid in said cup is preferably at such a level that said screen engages its upper surface thereby materially increasing the absorbing surface of the liquid as well as aiding in preventing splashing thereof.

The port 14 has fixed in it a nipple 17 connected to a conduit leading from the exhaust of the engine or other source of gas to be analyzed, and in addition the casing structure has formed in its side other ports 18, 19, 20, 21 and 22, all of which preferably extend radially through the casing wall. Further, thereis also a port formed in the side of the casing structure 1 so as to open into the same as well as on its front face in position to receive one end of a glass tube 24 which is curved in the form of a circular arc and held on the front edge of the casing structure by suitable clips or eyelets 25. The opposite end of said tube is preferably though

not necessarily sealed and it contains a body 26 of liquid such as mercury or non-vaporizing oil, the open end of the tube as well as about two-fifths of its length extending over or adjacent a segmental metal scale 27 provided with elongated openings 28 for the reception of screws 29 whereby it may be clamped in any adjusted position upon the front edge of the casing structure.

In addition to the main branched chamber 50 in the body of the plug 2, I provide a recess or port 30 formed in its periphery and so placed as to establish communication between the ports 22 and 23 when said plug has been moved to the proper position.

The graduations of the scale 27 are so placed that when the plug occupies the position in the casing illustrated in Fig. 6, the right hand end of the liquid column in the tube is opposite the zero mark of said scale. If it be assumed that the cup 16 is filled with the proper compound, such as caustic soda in liquid form, the gas to be tested or analyzed is delivered to the conduit connected to the nipple 17, and the plug 2 is turned by its handle 5 into the position indicated in Fig. 5, so that its port 10 communicates with the port 14 and its ports 11 and 12 respectively connect with the ports 18 and 20. The gas is thus allowed to flow into and through the chamber in the plug, so that any air in the latter is completely displaced. The plug is then turned to the intermediate position shown in Fig. 6, where it is permitted to remain for such a time as ten seconds, in order that the gas may be cooled preferably to the temperature of the plug and casing, after which it is further turned until it occupies the position shown in Fig 4, with the port 11 closed, the port 10 communicating through the port 13 with the absorbent container 16, and the port 12, through the port 23 in connection with the interior of the tube 24.

Under these conditions the caustic soda in said container and the carbon dioxid in the gas within the cavity of the plug react in the well known manner and the consequent removal of said carbon dioxid causes a partial vacuum to be formed, as a result of which the indicating liquid 26 within the tube 24 is drawn to the right by reason of the vacuum in the chamber 50. When the absorption of the carbon dioxid is complete, the liquid column comes to rest and a reading may be taken from the scale of the position of the right hand end of said column, the instrument being calibrated so that such a reading directly gives the proportion of carbon dioxid present in the gas under examination.

For this purpose the various graduations are marked on the scale by noting the positions assumed by the liquid column 26 when gases having known proportions of carbon dioxid are delivered to the apparatus. For example, a mixture of gases is first tested in any suitable manner as by the use of a standard instrument, to determine the proportion of carbon dioxid present, and after such a known mixture is admitted to my instrument, the resulting position of the liquid column 26 is noted after the absorption of the carbon dioxid in such gas. The other graduations or scale divisions may be similiarly obtained by observing and noting the positions of one end of the liquid column for different samples of gases having known proportions of carbon dioxid.

After each test the plug 2 may be turned into the position shown in Fig. 7, in order to admit air, it being noted that whenever it is desired to set or adjust the instrument, said plug is turned into the position shown in Fig. 6 so that its chamber 30 connects the ports 22 and 23. When in this position the liquid column 26 is free to move to the lowest part of the tube 24 and the scale 27 may be adjusted, after the screws 29 have been loosened, to bring the zero of its graduations in line with the right hand end of said liquid column.

In order that the operator may at all times know the relative positions of the various parts of the plug, the face thereof is provided with an indicating symbol 35, while the front edge of the casing side is notched or otherwise marked as indicated at 36, 37, 38 and 39, to describe the various positions of the ports when such indicating symbol is opposite such notch or mark.

As a result of the construction of parts above described, it is an easy matter to clean out the absorbing container 16 when this is necessary, since it may be easily unscrewed from the cap 15 and its contents removed and replaced. If it should be desired to clean any of the ports or passages, the cotter pin 9 may be removed, after which the plug 2 may be drawn out of the casing. Obviously there is no possibility of damage to the instrument from incorrect manipulation of the plug and it is noted that the teeth or recesses on the back of the casing are so placed that said plug is immovably held in any given position until removed therefrom by force applied to its handle 5.

It is noted that in turning the plug from the position shown in Fig. 5 to that shown in Fig. 6, the ports 18 and 20 are cut off from the chamber 50 of said plug before the latter is cut off from the source of gas and while this may result in a slight pressure within the plug, such excess is relieved when the plug is moved to the position shown in Fig. 7.

As will be understood by those skilled in this art, my apparatus is particularly valuable for use in connection with internal combustion engines, since by connecting its

conduit 17 to the engine exhaust, it is possible to make a succession of tests of the proportion of carbon dioxid resulting from different adjustments of the air and fuel controlling devices until that particular mixture of air and fuel is found which gives the highest percentage of carbon dioxid in the exhaust, thus making it possible to ascertain the conditions under which the engine may be most efficiently operated. Obviously the use of my invention is not confined to engines since it may be employed to indicate the percentage of carbon dioxid in stacks, mines, etc. If desired the left hand end of the tube 24 may be open as would be advisable when testing gases carrying but small percentages of carbon dioxid.

I claim:—

1. A gas analyzer consisting of a structure having ports; a rotary member therein having a chamber and ports capable of being connected to a source of gas to be examined; an absorbing device arranged to be placed in connection with said chamber through one of said latter ports; and means for visually indicating the percentage of a predetermined gas in the gaseous mixture delivered to said chamber.

2. A gas analyzer consisting of a casing; a rotatable plug therein having a chamber and ports; a device for absorbing certain of the constituents of a body of gas; means for successively connecting one of the ports of said chamber to a gas source and to said device; and means communicating with the chamber through another port for indicating the proportion of gas taken up by said absorbing device.

3. A gas analyzer consisting of a casing having a rotary tapered plug fitting therein and formed to provide a chamber; a container; gas absorbing material in said container; means for adjusting the position of said plug to successively connect the chamber thereof to a source of gas to be examined and to said container; and means for indicating the quantity of gas taken up by the material in the container.

4. A gas analyzer consisting of a casing; means for connecting said casing to a source of gas to be examined; an absorber also connected to the casing; a movable member in the casing having a chamber provided with ports and adjustable to place said chamber in communication either with the source of gas or with the absorber; with a pressure indicating device connected to be placed in communication with the chamber of said member when the latter is connected to the absorber.

5. A gas analyzer consisting of a movable structure having a chamber for isolating a definite volume of gas to be examined; a pressure indicating device; a gas absorber; and means for simultaneously placing the body of gas contained in the chamber of said structure in communication with said absorber and with the pressure indicating device.

6. The combination of a casing; means for connecting said casing to a source of gas to be examined; a container for gas absorbent material connected to the casing; a tube containing a body of indicating liquid mounted on the casing and connected to the same; with a member in the casing having a chamber formed to simultaneously communicate either with the source of gas and the atmosphere or with the tube and the container.

7. The combination of a casing having ports; a plug rotatable in said casing and provided with a chamber having openings formed to coöperate with said ports; a container for gas absorbing material connected to one of the ports; a conduit communicating with a source of gas to be examined and connected to another of the ports; a tube connected to a third port and containing a liquid column; and a scale for indicating the position of the liquid column.

8. The combination of a casing provided with a series of ports; a cup for gas absorbing material connected to one of the ports; a conduit connected to a gas source and to another of the ports; a curved tube mounted on the casing having one end sealed and its other end connected to a third port; with a rotary plug fitting the casing having a chamber provided with ports disposed to connect with ports leading to the gas supply and to the atmosphere respectively, when said plug is in one position, or to the absorber and to said tube when said plug is in another position.

9. The combination of a casing provided with a series of ports opening within it; a cup for gas absorbing material connected to one of the ports; a conduit connected to a gas source and to another of the ports; a curved tube mounted on the casing having one end sealed and its other end connected to a third port; and a rotary plug fitting the casing having a chamber provided with ports disposed to connect with ports leading to the gas supply and to the atmosphere respectively, when said plug is in one position, or to the absorber and to said tube when said plug is in another position, said plug having a port placed to establish communication between the atmosphere and the port leading to the tube when in a third position.

10. The combination of a casing having a tapering cavity on one face provided with teeth; a plug fitting said cavity and including a spindle portion extending through the end of the casing; a spring device on said

spindle portion tending to draw the plug into the casing and coöperating with the teeth thereon to hold the plug in any given position; a handle projecting oppositely to the spindle for turning the plug in the casing; ports opening into the casing; and a chamber in the plug having ports coöperating with the casing ports.

11. The combination of a casing having ports; a plug rotatable in said casing and having a chamber provided with ports; a tube having one end connected to one of said casing ports; means for holding the tube to the casing with its ends in relatively elevated positions; a body of liquid in the lower portion of the tube; a scale mounted on the casing with its graduations in position to coöperate with one end of the liquid body in the tube; means for connecting one of the ports of the casing to a source of gas to be examined; and an absorber connected to another one of the casing ports.

12. The combination of a casing having a series of ports; a cap connected to one of the ports; a container structure detachably connected to said cap; a screen in said container; a body of gas absorbing material in said container; means for connecting one of the casing ports to a source of gas to be examined; a pressure indicator connected to another one of the casing ports; with a member rotatable in the casing and having a chamber provided with ports whereby it may be either simultaneously connected to the gas source and to the atmosphere, or to said pressure indicator and to the absorber.

13. The combination of a casing having a series of ports; means for connecting one of the ports to a source of gas to be examined; a cup connected to another port; gas absorbing material in said cup; with a rotatable plug in the casing having a chamber and ports therefor whereby said chamber may be placed in connection either with the gas source or with the cup.

14. The combination of a casing having a series of ports; means for connecting one of the ports to a source of gas to be examined; a removable cup connected to another port; gas absorbing material in said cup; with a rotatable plug in the casing having a chamber and ports therefor whereby said chamber may be placed in connection either with the gas source or with the cup.

15. The combination of a casing having a series of ports; means for connecting one of the ports to a source of gas to be examined; a cup connected to another port; gas absorbing material in said cup; a loose body of inert material in the cup for preventing splashing of said absorbing material; with a rotatable plug in the casing having a chamber and ports therefor whereby said chamber may be placed in connection either with the gas source or with the cup.

In witness whereof I affix my signature.

ALFRED BUTCHER.