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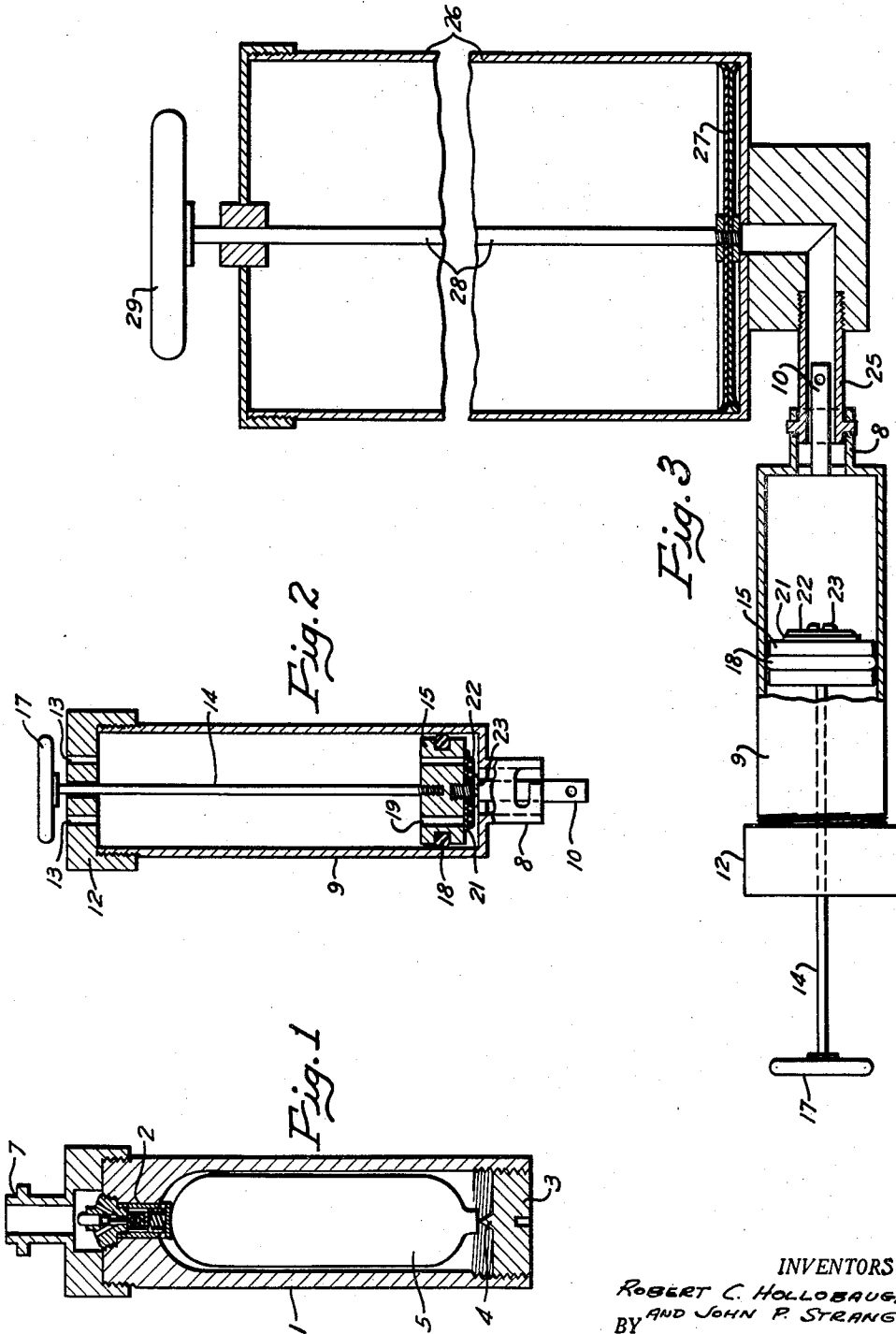
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FIELD CALIBRATOR FOR COMBUSTIBLE GAS ANALYZER

Filed Oct. 14, 1955

2 Sheets-Sheet 1



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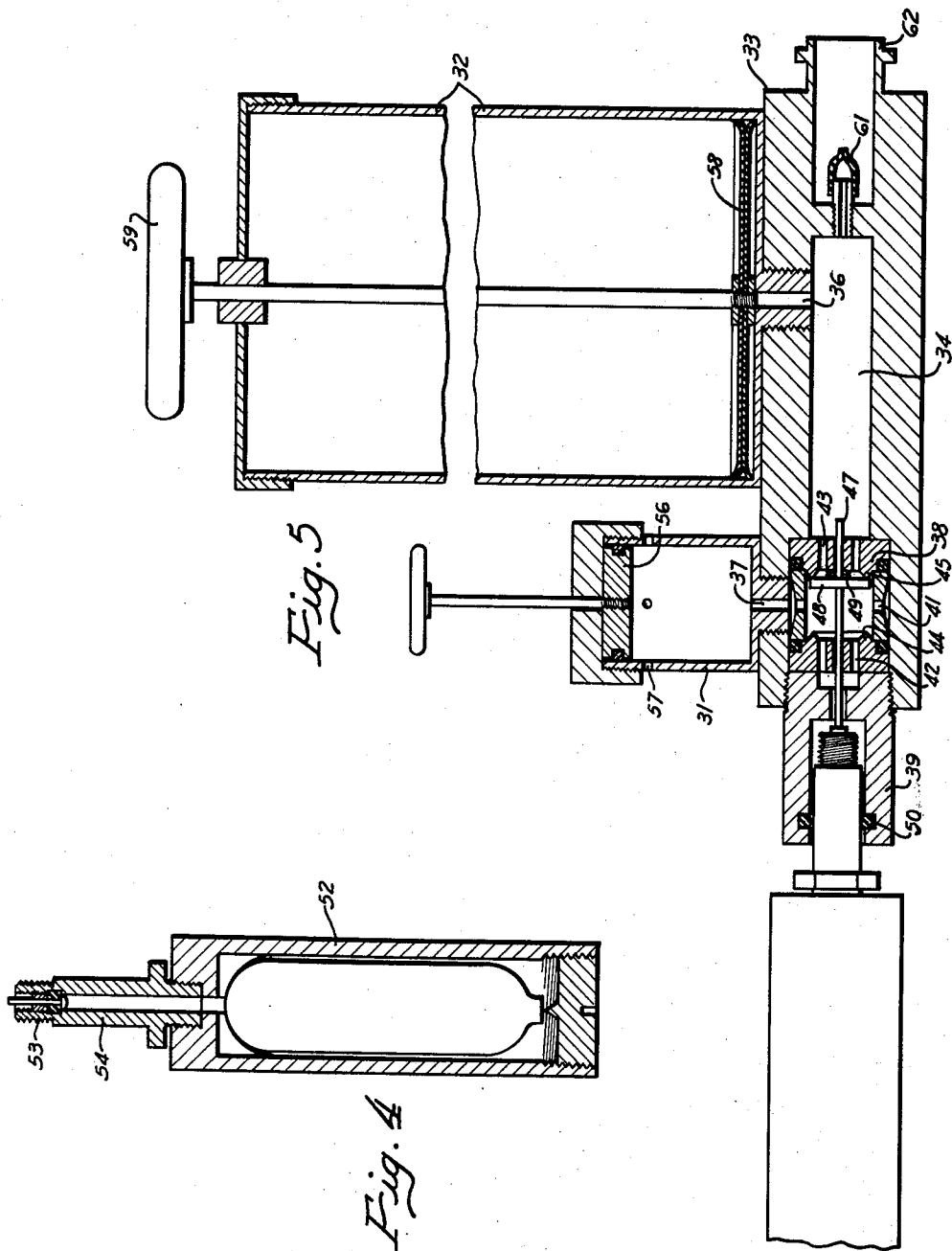
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FIELD CALIBRATOR FOR COMBUSTIBLE GAS ANALYZER

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5 Claims. (Cl. 73—1)

This invention relates to portable apparatus for calibrating combustible gas analyzers in the field.

Present calibrators used to standardize combustible gas analyzers are not portable. They are complicated and require a high degree of technical skill to operate them. One standard method of obtaining a known volume and concentration of gas in air for calibrating combustible gas analyzers requires constant gas and air flow rates, precision manometers, valves and pressure regulation, and a large amount of manipulative skill. In another standard apparatus, known as the static type, a fixed volume of gas or vapor is mixed with a fixed volume of air in a closed container. A gradual dilution of the supply takes place as samples are used in calibration, because the portion used is replaced with ambient air. This results in a constantly changing reading on the analyzing instrument, adding error to the calibration.

It is among the objects of this invention to provide a calibrator which is portable and compact, which is simple and accurate, which uses readily available compressed gas cartridges, and with which a change in gas concentration does not take place as the mixture is withdrawn from the calibrator to the combustible gas analyzer being calibrated.

In accordance with this invention, a receiver having a predetermined capacity is filled with a combustible gas at atmospheric pressure. Preferably, this gas is obtained directly from a high pressure dispenser filled with compressed gas. The receiver has an outlet passage at one end and an air inlet at the other end. A cylinder of predetermined larger capacity than the receiver is provided with an inlet opening which can be connected with the receiver passage. A manually movable piston is disposed in the cylinder, normally adjacent its opening. When the piston is moved away from the opening the gas is drawn from the receiver into the cylinder and then, because of the larger capacity of the cylinder, this gas is followed by air drawn through the air inlet of the receiver until the cylinder is filled with a mixture of gas and air. Since the cylinder has a known capacity and a known volume of combustible gas is drawn into it, it will be filled with known proportions of gas and air. While the mixture is being withdrawn from the cylinder, the piston is moved simultaneously toward the outlet so that the pressure in the cylinder will not be reduced, which might allow air to be drawn in and dilute the mixture.

The invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a longitudinal section through a compressed gas dispenser;

Fig. 2 is a similar section through the gas receiver;

Fig. 3 is a vertical section through the mixing cylinder and the gas receiver temporarily connected with it;

Fig. 4 is a view, similar to Fig. 1, of a modified compressed gas container; and

Fig. 5 is a vertical section through a modified receiver

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and mixing cylinder arrangement, coupled temporarily to the container of Fig. 4.

Referring to Figs. 1 and 2 of the drawings, a high pressure gas dispenser 1 has an outlet at one end that is normally closed by a spring pressed valve 2. Screwed into the opposite end of the dispenser is a plug 3 that has a central point 4 projecting from its inner surface. This point is for puncturing the end seal of a compressed gas cartridge 5 disposed in the dispenser. The cartridge contains a combustible gas of known lower explosive limit and high purity. Butane is especially suitable for this purpose, although propane and other gases can be used. Screwed onto the valve end of the dispenser is a coupling provided with a bayonet joint member 7 which is adapted to be inserted and locked in another tubular bayonet joint member 8 connected to the lower end of a gas receiver 9, as shown in Fig. 2. Projecting below member 8 is a pin 10 that will engage the stem of valve 2 and press it down to open the valve when the dispenser and receiver are connected by means of the bayonet joint. The body of receiver 9 preferably is cylindrical and has a cap 12 on its upper end provided with air inlets 13. The center of this cap has an opening through it, in which the rod 14 of a plunger 15 slides. The upper end of the rod may be provided with a handle 17 for pushing the plunger down in the receiver. The plunger is encircled by a packing ring 18 that presses against it and the side of the receiver to prevent gas from escaping past the plunger. The plunger also has air inlets 19 extending through it. A check valve for these last inlets is formed by covering their lower ends with a flexible rubber disc 21 that normally is held up against the plunger by means of a light spiral spring 22 encircling a screw 23 that is screwed into the center of the plunger.

When the compressed gas dispenser 1 is connected by the bayonet joint to the receiver 9 with the plunger in its lower position, there is only a negligible amount of air in the receiver below the plunger. Connection of the two members causes pin 10 to open the valve in the top of the gas dispenser and allow the expanding gas, which previously has been released from cartridge 5 by puncturing it with point 4, to enter the bottom of the receiver and push the plunger upward. The sidewall of the receiver may be made of transparent material and calibrated or the stem may be calibrated to indicate the capacity of the chamber below the plunger at different elevations. The plunger can be allowed to rise until it strikes the top of the receiver, or the gas dispenser can be removed from the receiver as soon as the plunger rises above the desired calibration mark. The moment the gas dispenser is disconnected from the receiver, the pressure of the combustible gas in the receiver becomes atmospheric. The plunger then is pushed down until a gas-filled chamber of the desired capacity is indicated by the calibration marks. This previously determined capacity represents the volume of combustible gas at atmospheric conditions necessary for a chosen reading in the range of 0 to 100% of the lower explosive limit after air dilution.

The receiver inlet and outlet passage through member 8 then is connected with a short pipe 25 that leads to the inlet and outlet opening of a mixing cylinder 26 which has a much greater, but known, capacity than the receiver, as shown in Fig. 3. A piston 27, designed to prevent leakage past it in either direction, is mounted on the lower end of a rod 28 which slides through the top of the cylinder. The normal position of the piston is down as close to the bottom of the cylinder as possible. As soon as the receiver is connected to the cylinder, the piston is raised by pulling up on its handle 29 and this draws or sucks the gas out of the receiver and into the cylinder. There is no resistance to withdrawal of gas from the receiver, because plunger check valve 21 will be drawn away from air inlets

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19 and thus will allow air to enter the top of the chamber as fast as the gas leaves its bottom. As soon as all of the combustible gas has entered the mixing cylinder the continued raising of the piston will draw in air from the receiver, flushing the gas therefrom, until the piston can move no higher. The cylinder then will be full of a mixture of known quantities of combustible gas and air, so the concentration of gas likewise will be known. The receiver then is disconnected from the cylinder, and a sample line (not shown) to the combustible gas analyzing instrument that is to be calibrated is connected in its place to pipe 25. As the gas and air mixture is drawn from the cylinder into the analyzer, the piston in the mixing cylinder will descend, reducing the volume of sample in the cylinder at the same rate that it is removed. Consequently, the gas-in-air concentration and its volume remain constant during sample withdrawal, for air will not be drawn in and the sample will not expand. The weight of the piston will even exert a slight positive pressure on the mixture. This invention results in a unique and efficient method for drawing in measured volumes of gas and air and mixing them together under ideal conditions.

In the modification of the invention shown in Figs. 4 and 5 of the drawings, the gas receiver 31 and the mixing cylinder 32 are permanently connected by mounting them on a base 33 that is provided with a conduit 34 extending horizontally through it. The inlet and outlet opening 36 of the cylinder opens into the top of this conduit near one end, while the inlet and outlet passage 37 of the receiver opens into the top of the conduit near its opposite end. Mounted in the conduit beneath the receiver is a valve mechanism which includes a barrel 38 held in place against a shoulder in the conduit by a socket 39 screwed into the outer end of the conduit. The barrel is hollow and has a concave outer surface spaced from the surrounding wall of the conduit. The sidewall of the barrel also is provided with circumferentially spaced radial holes 41. The ends of the barrel have axial passages 42 and 43 through them, encircled inside the barrel by valve seats 44 and 45, respectively. A valve stem 47 is slidably mounted in two of these passages and carries a valve member 48 that normally is pressed against the outer seat 44 by a coil spring 49. The stem also extends out through a large passage in the inner end of the socket, but stops short of an O-ring 50 mounted in an internal recess in the socket.

A high pressure gas dispenser 52, similar to the one previously described, has an automobile tire type of valve 53 in its outlet nipple 54. When this nipple is inserted in socket 39, the space between it and the wall of the socket is sealed by the O-ring. The nipple is pushed in against the valve stem 47 far enough to push valve member 48 against the inner seat 45 to cut off communication between the receiver and cylinder. Still further insertion of the nipple in the socket causes the now stationary valve stem to open valve 53 to allow compressed gas to flow up into the receiver. The plunger 56, which normally is at the bottom of the receiver, is forced up against the top of the receiver by the entering gas, forming a chamber of predetermined capacity. Just before the plunger reaches the top of the receiver it uncovers some air vents 57 in the sidewall and thus allows gas to start escaping from these vents. When this occurs the gas dispenser is pulled out of the socket, leaving the gas in the receiver at atmospheric pressure, whereupon coil spring 49 will force valve member 48 to the left against the outer seat to place the receiver in communication with the cylinder. When the piston 53 in the mixing cylinder 32 is raised by handle 59, the combustible gas will be drawn down out of the receiver through passage 37 and conduit 34 and up into the cylinder, because a check valve 61 in the right hand end of the conduit will close and prevent air from being drawn in.

As gas is drawn out of the receiver in this manner, air enters the vents 57 above it and flushes the gas into the cylinder until the latter is filled with measured volumes

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of gas and air. The plunger 56 then is moved down to the bottom of the receiver to prevent air from being drawn from the receiver when the outlet connection 62 of the conduit 34 is connected with the instrument that is to be calibrated. Whenever a sample is furnished to that instrument, the piston in the mixing cylinder is lowered in order to reduce the size of the chamber therein a like amount.

According to the provisions of the patent statutes, we have explained the principle of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. Apparatus for producing a mixture of combustible gas and air in predetermined proportions, comprising a receiver having a chamber of predetermined capacity provided with a combined inlet and outlet passage at one end and an air inlet at the other end, means for filling the chamber with a combustible gas through said passage, a cylinder of predetermined larger capacity than said chamber provided with a combined inlet and outlet opening, a manually movable piston in the cylinder normally adjacent said opening, and means for connecting said passage and opening, the piston being movable away from the cylinder opening to draw the gas only from said chamber through said passage and into the cylinder through said opening followed by air drawn through said air inlet and chamber and cylinder opening until the cylinder is filled with said gas and air.

2. Apparatus for producing a mixture of combustible gas and air in predetermined proportions, comprising a receiver having a chamber of predetermined capacity provided with an outlet passage at one end and an air vent at the other end, a plunger in the receiver normally adjacent said passage and provided with an air inlet there-through, a check valve for said inlet, means for supplying a combustible gas to said receiver to move the plunger toward said vent, means for manually moving the plunger in the opposite direction the distance necessary to produce said chamber of predetermined capacity, a cylinder of predetermined larger capacity than said chamber provided with an inlet opening, a manually movable piston in the cylinder normally adjacent said opening, and means for connecting said passage and opening, whereby when the piston is moved away from the opening the gas will be drawn from said chamber into the cylinder followed by air drawn through said air inlet and chamber until the cylinder is filled with said gas and air.

3. Apparatus for producing a mixture of combustible gas and air in predetermined proportions, comprising a receiver having a chamber of predetermined capacity provided with an inlet and outlet passage at one end and an air vent at the other end in its sidewall, a plunger in the receiver normally adjacent said passage, means for supplying a combustible gas to said passage to move the plunger back across said vent, a cylinder of predetermined larger capacity than said chamber provided with an inlet and outlet opening, a piston in the cylinder normally adjacent said opening, and means for connecting said passage and opening, whereby when the piston is moved away from the opening the gas will be drawn from said chamber into the cylinder followed by air drawn through said vent and chamber until the cylinder is filled with said gas and air.

4. Apparatus for producing a mixture of combustible gas and air in predetermined proportions, comprising a receiver having a chamber of predetermined capacity provided with an inlet and outlet passage at one end and an air inlet at the other end, a cylinder of predetermined larger capacity than said chamber provided with an inlet and outlet opening, a conduit connecting said passage and opening, means for filling said chamber with a combustible

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gas at atmospheric pressure, a manually movable piston in the cylinder normally adjacent said opening, whereby when the piston is moved away from the opening the gas will be drawn from said chamber into the cylinder followed by air drawn through said air inlet and chamber until the cylinder is filled with said gas and air, said conduit having an outlet for withdrawing said mixture from said cylinder, and a check valve in said conduit outlet for closing it while said gas and air are being drawn into the cylinder.

5. Apparatus for producing a mixture of combustible gas and air in predetermined proportions, comprising a receiver having a chamber of predetermined capacity provided with an inlet and outlet passage at one end and an air inlet at the other end, a cylinder of predetermined larger capacity than said chamber provided with an inlet and outlet opening, a conduit connecting said passage and openings, means for filling said chamber with a combustible gas at atmospheric pressure, a manually movable piston in the cylinder normally adjacent said opening, whereby when the piston is moved away from the open-

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ing the gas will be drawn from said chamber into the cylinder followed by air drawn through said air inlet and chamber until the cylinder is filled with said gas and air, said conduit having an inlet adapted to be connected with said chamber-filling means, normally closed valve means in said conduit inlet and normally open valve means in said conduit between said receiver and cylinder, and means actuated by said chamber-filling means for opening said first-mentioned valve means and simultaneously closing said second-mentioned valve means while the chamber is being filled with gas.

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