Dec. 6, 1966 L. K. BARNES 3,289,481

GAS SAMPLING DEVICE

Filed Dec. 24, 1964

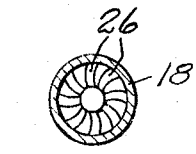


Fig 2

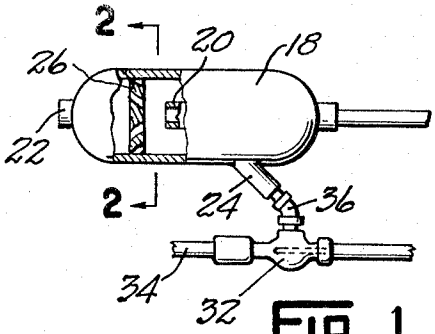
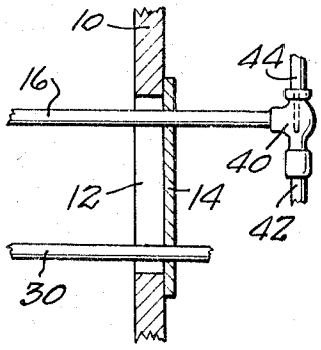


Fig 1



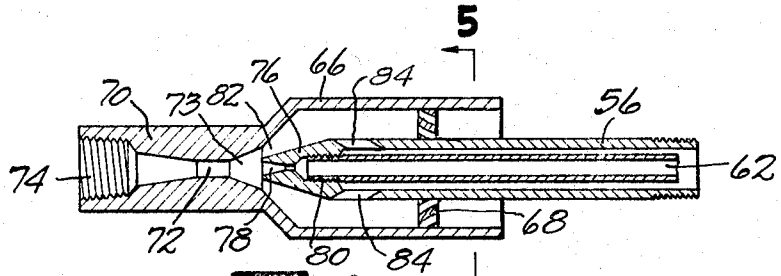


Fig 4

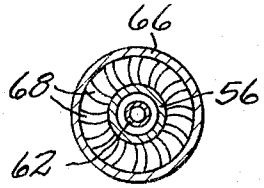


Fig 5

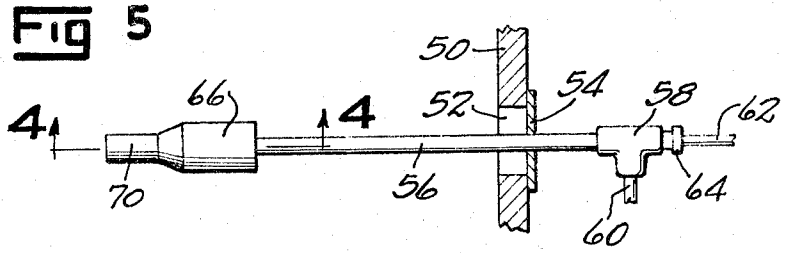


Fig 3

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GAS SAMPLING DEVICE

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This invention relates to gas sampling devices, and more particularly to devices for taking samples of gas from furnaces and other processing equipment, for the purpose of analysis thereof.

Gases in furnaces, kilns and other processing equipment commonly contain substantial quantities of suspended impurities or foreign matter. Such impurities must be removed before the gas can be analyzed. It is the primary object of this invention to provide improved means for obtaining a gas sample and for separating impurities from the gas sample for discharge into the gas generating equipment or elsewhere remote from the outlet of the gas sample.

A further object is to provide a device of this character which is mounted in a gas generating apparatus and is provided with a novel means for separating impurities suspended in a gas sample for redelivery to the gas generating equipment, so that gas supplied at the outlet exterior of the generator will be substantially clean.

A further object is to provide a device of this character wherein a casing having a gas inlet and an impurity outlet spaced from the gas inlet mounts means for centrifugally separating impurities from the gas and diverting them in a path clear of gas outlet means located centrally in the casing between the gas inlet and the impurity outlet.

Other objects will be apparent from the following specification.

In the drawing:

FIG. 1 is a side view of the device constituting one embodiment of the invention, with parts shown in section;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a side view illustrating another embodiment of the invention;

FIG. 4 is an enlarged axial sectional view taken on line 4—4 of FIG. 3; and

FIG. 5 is a transverse sectional view taken on line 5—5 of FIG. 4.

Referring to the drawing which illustrates the preferred embodiment of the invention, the numeral 10 designates the wall of a kiln, furnace or other gas-generating or gas-handling device which has an access opening 12 spanned by a removable closure 14. An elongated rigid tube or conduit 16, formed of a metal capable of withstanding the temperature and other conditions within the furnace or gas-generating apparatus at the point at which the gas sample is to be withdrawn, is carried by the removable closure 14 and extends therethrough with its inner end within the furnace or kiln. At its inner end the tube 16 supports a casing 18 which is preferably of generally cyclindrical configuration having opposed ends. A conduit portion 20 projects through one end and terminates at an open end portion positioned substantially mid-length of the casing 18 and substantially centrally. Inlet tube portion 20 is positioned substantially co-axially within the casing 18 and communicates with the tube or conduit 16. The end of the casing 18

remote from the tube 16 is provided with a gas inlet 22 preferably substantially coaxial with the casing 18 and of a size to permit unrestricted flow therethorugh into the casing of gas and suspended impurities. The casing 18 has an outlet tube 24 depending therefrom at its lowermost portion adjacent the point of connection of the casing 18 with the tube 16 and preferably at a point intermediate the length of the tube portion 20. A cyclone dust separator 26 is mounted in the casing 18 between and spaced from the inner end of the inlet tube 20 and the gas inlet 22. The cyclone dust separator may be of any suitable type and preferably includes a circular series of vanes arranged spirally in the casing to centrifugally deflect particles of dust and other solid material contained in a gas sample to cause the same to move within the casing adjacent the casing wall and clear of the open end of the inlet tube 20 incident to flow of gas and suspended matter from the gas inlet 22 as urged by suitable flow inducing means.

A second conduit 30 is carried by the closure member 14 and extends therethrough to a point adjacent to the casing 18. Conduit 30 is connected to a source of steam, air or other suitable fluid under pressure located externally of the furnace or kiln 10. The inner end of the tube or conduit 30 mounts an ejector or aspirator 32 which is connected with a discharge conduit 34. A fitting 36 connects the impurity outlet tube 24 of the casing 18 with the inlet of the ejector or aspirator 32. The ejector or aspirator provides the means for creating a flow of impurity laden gas into the casing 18 through its inlet 22 and thence therethrough past the cyclone dust separator to the outlet tube 24, and thence through the ejector 32 for discharge through the discharge conduit 34.

Unless the process pressure is sufficient to produce a sample flow without pumping, the outermost end of the conduit 16 is perferably connected to the inlet of an aspirator or ejector 40, or other suitable pump, located externally of the furnace or other gas-generating device and having a discharge conduit 42 connected thereto. The ejector 40 also has connection with conduit 44 connected to a source of fluid under pressure, such as a boiler which supplies steam, or a compressor which supplies compressed air, although the use of steam is preferred.

In the operation of the device, assuming the flow of steam or compressed air through conduit 30 to the ejector or aspirator 32, a flow of gas with suspended impurities in the gaseous atmosphere within the gas-generating unit is caused to flow through the casing 18 at a controlled rate from the inlet 22 to and through the cyclone dust separator. The impurities separated from the gas, together with some of the gas sample, are either drawn or advanced through the casing 18 for discharge at 24 to the ejector 32 which discharges them through the discharge conduit 34 at any suitable point, preferably within the gas-generating unit, or at a collection point which may be located externally of the gas-generating unit. A part of the gas sample which is free of the initial impurities contained therein then passes through conduits 20 and 16 to the ejector 40 and the outlet or discharge conduit 42 as induced or pumped by the passage of steam or other fluid into the ejector or pump from the inlet conduit 44. The use of steam is preferred since use of air would dilute the gas sample and require calibration of the gas analyzer to which the gas and conveying medium are discharged by the discharge conduit 42.

Thus it will be apparent that, where steam is used, suitable condensing means may be introduced in the discharge conduit 42 in advance of the gas analyzer for removal of moisture content from the gas sample.

A second embodiment of the invention is illustrated in FIGS. 3 to 5. In this construction the numeral 50 designates the wall of a furnace or kiln or other gas-generating device having access opening 52 spanned by a closure member 54 which carries an elongated tube 56 extending through said closure and into the gas-generating device. At its outer end the tube 56 mounts a T-fitting 58 connected to a gas discharge conduit 60. A conduit 62, constituting a steam or other suitable compressed fluid line, passes through the fitting 58 and the tube 56 with clearance. A packing gland or other seal 64 closes the clearance space between the conduit 62 and the fitting 58 at the point at which the conduit enters the fitting.

The inner end of the tube 56 extends into a casing member 66 of substantially cylindrical shape which is open at one end to receive the tube 56 with clearance. Any suitable means are provided to mount the casing 66 concentrically in the inner end of the tube 56 and, as here shown, such means constitute a plurality or circumferential series of vanes 68 arranged spirally or purposes to be described. The casing 66 has a reduced tubular extension portion 70 at one end thereof having a reduced bore which constitutes an ejector recovery jet 72. The other end of the tubular casing extension 70 preferably has an enlarged screw-threaded bore part 74 at which may be connected a discharge tube (not shown).

A nozzle 76 is carried by the inner end of the tube 56 and has a restricted ejector nozzle orifice 78. The inner end of the conduit 62 is screw-threaded in the nozzle part 76 at 80 so as to discharge steam or fluid under pressure through the restricted ejector nozzle orifice. The nozzle orifice is axially aligned with and located adjacent to the flaring mouth portion 73 at the inner end of the ejector recovery jet so as to discharge thereto. The nozzle 76 has clearance with the casing at its tip to provide an annular passage 82 therearound. The tube 56 has one or more inlet openings 84 therein between the nozzle 76 and the vanes 68.

As steam or other fluid under pressure passes through the conduit 62 and the nozzle 76 and is discharged through the ejector recovery jet 72, a flow of gas from within the gas generator is induced through the open end of the casing 66, the vanes 68, to the annular passage 82 and the jet passage 72. The vanes 68 serve as a dust separator tending to centrifugally deflect or divert dust particles or particles of solid matter to cause them to impinge upon and follow the inner surface of the casing 66 to the jet 72, thereby deflecting them away from the openings 84 in the tube 56. Gas which is substantially clean and free of impurities can enter the openings 84 and flow through the tube 56 and around the steam tube 62 to the T-fitting 58 and the gas discharge conduit 60.

While the drawing illustrates the device mounted essentially in a horizontal position, it may also be mounted in vertical or inclined position, if convenient or desirable to do so, without sacrifice of its utility and functioning.

While the preferred embodiments of the invention have been illustrated and described, it will be understood that changes in the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. Apparatus for securing a sample of gas from an enclosure having a gaseous atmosphere containing suspended impurities, comprising a casing, gas inlet means communicating with said casing and with said enclosure, said casing having an impurity outlet spaced from said gas inlet means and a gas outlet means located between said gas inlet means and impurity outlet and positioned centrally in said casing and substantially parallel to said inlet means, means for aspirating gas and suspended impurities into said casing through said gas inlet means and through said casing past said gas outlet means to said impurity outlet, and means located in said casing between said gas inlet means and said gas outlet means for centrifugally separating impurities from gas and laterally deflecting said impurities in said casing in a path clear of said gas outlet means as gas and impurities are advanced in said casing toward said impurity outlet.

2. Apparatus for securing a sample of gas from an enclosure having a gaseous atmosphere containing suspended impurities, comprising a casing, gas inlet means communicating with said casing and with said enclosure, said casing having an impurity outlet spaced from said gas inlet means and a gas outlet located between said gas inlet means and impurity outlet and positioned centrally in said casing, means for aspirating gas and suspended impurities into said casing through said gas inlet means and through said casing past said outlet to said impurity outlet, and a circular series of vanes arranged spirally in said casing between said gas outlet means and said gas inlet means for centrifugally deflecting impurities passing through said casing toward said impurity outlet.

3. Apparatus as defined in claim 1, wherein said casing is adapted to be located in an enclosure containing gas to be sampled, and said gas inlet means constitutes an opening in said casing.

4. Apparatus as defined in claim 1, wherein said aspirating means includes means for supplying a flow of fluid under pressure from a source located exteriorly of said enclosure.

5. Apparatus as defined in claim 1, and means for inducing flow of gas in said gas outlet means.

6. Apparatus as defined in claim 1, wherein said impurity outlet includes a conduit extending exteriorly of said casing and discharging into said enclosure, said aspirating means being interposed in said impurity discharge conduit.

7. Apparatus as defined in claim 1, wherein said impurity discharge includes an ejector recovery jet portion carried by said casing and said aspirating means includes a nozzle having an orifice adjacent to and substantially aligned with said recovery jet portion and a fluid supply line connected to said nozzle, said gas outlet including a conduit encircling said fluid supply line with clearance and having an aperture located adjacent said nozzle.

8. Apparatus for securing a sample of gas from an enclosure having a gaseous atmosphere containing suspended impurities, comprising a casing adapted to be located in said enclosure, a gas outlet conduit having an inner open end positioned substantially centrally in said casing and adapted to extend exteriorly of said enclosure, a gas inlet opening in said casing spaced from the inner open end of said gas outlet conduit, an impurity outlet means connected to said casing remote from said inlet opening and so located that gas and impurities flowing thereto pass the inner open end of said gas outlet conduit, a circular series of spirally arranged vanes in said casing located between said inlet opening and the inner open end of said gas outlet conduit to deflect impurities passing through said casing to said impurity outlet means in a path clear of said inner open end of said gas outlet conduit, and means for aspirating gas and suspended impurities into and through said casing and vanes to said impurity outlet means and including a fluid pressure line extending exteriorly of said enclosure.

9. Apparatus as defined in claim 8, wherein said aspirating means is located in said impurity outlet means.

10. Apparatus as defined in claim 8 wherein said aspirating means constitutes a nozzle in said casing, and said fluid pressure line extends longitudinally through said gas outlet conduit with clearance.

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