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OPTICAL DEVICE FOR THE EXAMINATION OF SMOKE AND DUST LADEN GAS

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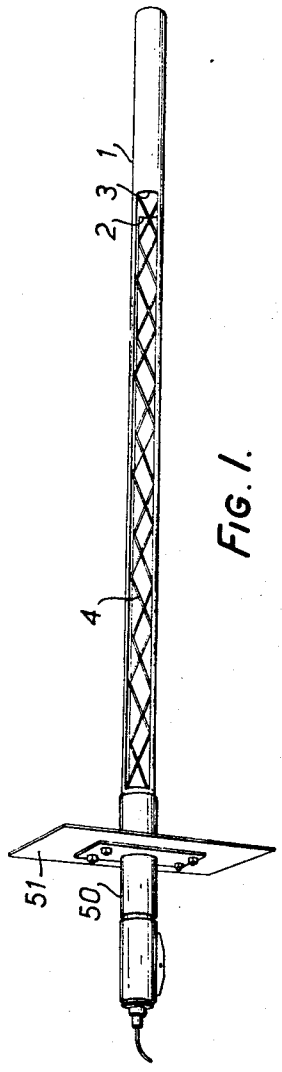



FIG. 1.

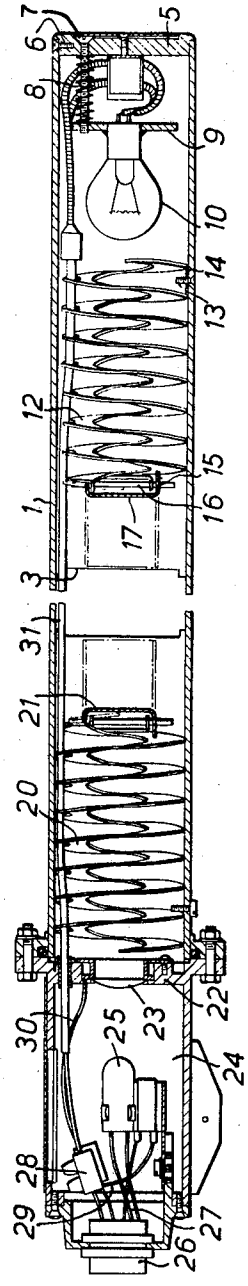



FIG. 2.


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# OPTICAL DEVICE FOR THE EXAMINATION OF SMOKE AND DUST LADEN GAS

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U.S. Cl. 250—218 5 Claims

## ABSTRACT OF THE DISCLOSURE

An optical device for the examination of smoke or dust-laden gases consisting of two collinear tubular portions connected together by a support member, one tubular portion containing a light source and the other containing a photo-sensitive device. The smoke or dust-laden gas is arranged to pass upwardly between the two tubular portions and thus between the light source and the photo-sensitive device. In order to prevent dust or dirt particles from being deposited either on the light source or on the photo-sensitive device baffles are inserted into each tubular portion, leaving an axial light path between the source and the photo-sensitive device, the baffles breaking up eddies in the dust carrying gas so that the dust is deposited between the baffles.

This invention relates dust traps for use in the examination of a smoke or dust-laden gas such as flue gas from the furnace of a boiler. It is often desirable to optically examine gas carrying smoke or dust either visually or by means of light sensitive instruments. However, a difficulty is encountered since the dust is liable to be deposited on the instrument by which, or on the window through which, the observation is being made. Such a window may be in the duct wall and thus be between the outside and the interior of the duct or, in the case of instrument measurement, the instrument may be partly or wholly positioned within the duct. Various means have been proposed for preventing the deposition of dust in such circumstances but they all suffer from one disadvantage.

According to the present invention a dust trap for use in the optical examination of a smoke or dust-laden gas comprises a tube which is open at one end and contains baffles extending inwardly from the tube wall and leaving an axial light path along the tube to the open end and has a barrier across the tube beyond the baffles from the open end.

In use the open end is in communication with the interior of the duct carrying the gas and the axis of the tube is perpendicular to the direction of flow of gas. It has been found that observation can be made through the tube without deposition of dust at a distance along the tube from the open end. The reason for this is believed to be that in a tube extending into a duct in which gas is flowing any gas-carrying dust which enters the tube forms eddies and the baffles break up the eddies so that the dust is deposited between the baffles.

The baffles may be formed in various ways. For example, they may be constituted by annular discs which are spaced from one another along the length of the tube. However, in the preferred construction they are formed as a continuous strip arranged as a helix with the outer edge of the strip in contact with the inner surface of the tube and the inner edge bounding the axial light path. Preferably the inner edge of the baffles should not



be smoothed or rounded but are preferably chambered to a sharp edge to prevent an accumulation of dust which might interfere with the clear passage of the light rays along the axial path.

In one important application of the invention, an optical probe, which may comprise an elongated support member, carries at one end a dust trap which includes a light sensitive device in the tube beyond the baffles from the open end and at the other end a dust trap having a mounting for an electric lamp bulb or similar light source beyond the baffles from the open end, the longitudinal axes of the dust traps being aligned and the open ends facing one another. The barrier of the first dust trap may be at least partly transparent and positioned between the photo-sensitive device and the baffles so that the photo-sensitive device is protected from the gases being examined. The transparent part of the barrier may be a lens directing light passing through the dust trap onto the photo-sensitive device.

The invention may be carried into practice in various ways but an optical probe incorporating two dust traps will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of the probe; and

FIGURE 2 is a fragmentary longitudinal section of the probe.

The probe shown in the drawings is intended to be introduced into a flue gas duct of a fuel burning appliance. For example, the instrument may be used as a dust monitor for pulverised fuel boilers or as a smoke meter for this or other forms of fuel burning appliance.

The probe comprises a steel tube **1** which is 7 ft. 6 in. long. Over approximately the central 4 ft. 6 in. of this length the opposite walls of the tube are slotted out, one of the slots or aperture **2** being slightly shorter at each end than the other slot or aperture **3**. The rigidity of the tube **1** is restored by reconnecting the longitudinal edges of the slot by diagonal stiffening members formed by zig-zag steel rods **4**. As shown in the drawings the tube **1** is sealed against the entry or exit of any gas save through apertures **2** and **3**.

FIGURE 2 is a longitudinal section through the probe with the central portion having the slots omitted. One end of the tube is closed by a disc **5** retained by screws **6** and supporting screws **7** on which a mounting **9** for an electric lamp bulb **10** is resiliently carried. Between the bulb **10** and the rear end of the slot **3** there are a number of baffles formed by a strip **12** which is formed into a helix with the outer edges in contact with the inner surface of the tube **1** and with the inner edges bounding an axially extending passage through which light rays from the bulb **10** can pass along the axis of the tube. The strip is retained in position by a screw **13** passing through a bracket **14** secured to the strip. The inner edge of the strip bounding the central passage is chamfered to a sharp edge. A channel-shaped bracket **15** is secured to the outermost baffle and hinged to this bracket by a pin **16** is a channel-shaped flap **17**, the edges of the flanges of which are shaped to engage with the flat surface of the end baffle. The flap is normally open but, as will be explained below, is closed during insertions of the probe into a gas stream. The strip **12** and the part of the tube in which the strip is contained form a dust trap which is open at the left hand end as viewed in FIGURE 2 and is closed at the right-hand end by the disc **5**. In use, gas passing from the slotted portion of the tube **1** through the central passage in the dust trap will be slowed down by the dust trap and the dust will be deposited before the gas reaches the bulb **10**. A heater may be provided in the right-hand end of the probe to prevent condensation and subsequent corrosion which may occur because of excessive cooling due to the exposed position of this end of

the probe or because of the high dew point of the gases during use of the probe.

At the left-hand end of the tube **1** as seen in FIGURE 2 there is a second helical strip **20** forming a second dust trap similar to that already described and having a closure flap **21** similar to the flap **17**. Extending across the tube beyond the baffles formed by the strip **20** is a barrier **22** the central part of which is formed by a lens **23**. This end of the tube forms a chamber **24** accommodating a photo-sensitive device **25**. The end wall of the chamber **24** carries a socket **26** for external connections. Output leads **27** extend from the photo-sensitive device to the socket for connection to indicating or recording apparatus. Power leads extend from the socket to connectors **28** from which leads **29** extend to the photo-sensitive device, leads **30** extend to a heater around the lens **23** and leads **31** extend to the electric lamp bulb **10**.

The instrument is used as follows. The tube **1** is slid through a spigot **50** (FIGURE 1) formed in the side wall **51** of a gas duct in which, it will be assumed, the direction of flow of gas is upwards. During insertion the longer slot **3** is on the underside and the flaps **17** and **21** hang down and shut the passages through the dust traps in order to prevent the admission of dust laden gas. When the probe is fully inserted, it is rotated through 180° whereupon the flaps will fall open. When a reading is required, the lamp **10** is switched on and the intensity of illumination falling on the photo-sensitive device **25** is measured by an appropriate meter. The magnitude of this measurement will depend upon the opaqueness of the gas passing through the slots in the tube. The fact that the lowermost slot **2** is somewhat shorter than the upper slot **3** will produce a very small ejector effect across the mouth of the dust trap, this inhibiting the entry of gas into the traps. Any gas that does enter the traps will be eddying and will very quickly be slowed down by the baffles so that particles suspended in the gas will be deposited between the baffles. A datum reading with which the readings of opaqueness can be compared can be obtained by withdrawing the instrument from the duct and taking a reading in clear air.

What we claim as our invention and desire to secure by Letters Patent is:

**1.** An optical device for the examination of smoke or dust-laden gas comprising:

(a) an elongated hollow tube comprising a tubular wall having closed ends,

(b) a passage for said gas through said tube comprising opposed apertures in said tubular wall, said tube being sealed against the entry or exit of any gas save through said passage,



(c) a light source within said tube adjacent one of said closed ends,

(d) a photo-sensitive device within said tube adjacent the other of said closed ends,

(e) a first dust trap within said tube and between said passage and said light source, and

(f) a second dust trap within said tube and between said passage and said photo-sensitive device, said first and second traps comprising baffles mounted in said tube and extending inwardly from the inner surface of said tube wall and leaving an axial light path from said light source to said photo-sensitive device.

**2.** A device as claimed in claim **1** in which said baffles are formed by a continuous strip arranged as a helix with the outer edge of said strip in contact with said inner surface of the tube and the inner edge of said strip bounding said axial light path.

**3.** A device as claimed in claim **1** in which the edges of said baffles bounding said axial light path are sharp.

**4.** A device as claimed in claim **1** which includes pivot means mounted on the nearest of said baffles to said passage and a flap freely carried by said pivot means and having a closed position closing said axial light path and an open position so that said flap falls open under gravity when the dust trap is orientated to a predetermined position.

**5.** A device as claimed in claim **1** in which the apertures are formed by diametrically opposed longitudinally extending slots and in which there are stiffening members bridging said slots.


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