June 13, 1950 A. H. HOBELMANN 2,510,977

DETECTION OF SUSPENDED MATTER IN GASES

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Fig. 1.

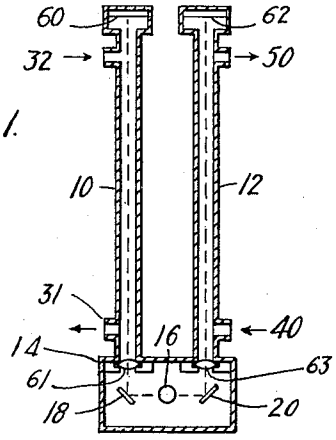


Fig. 2.

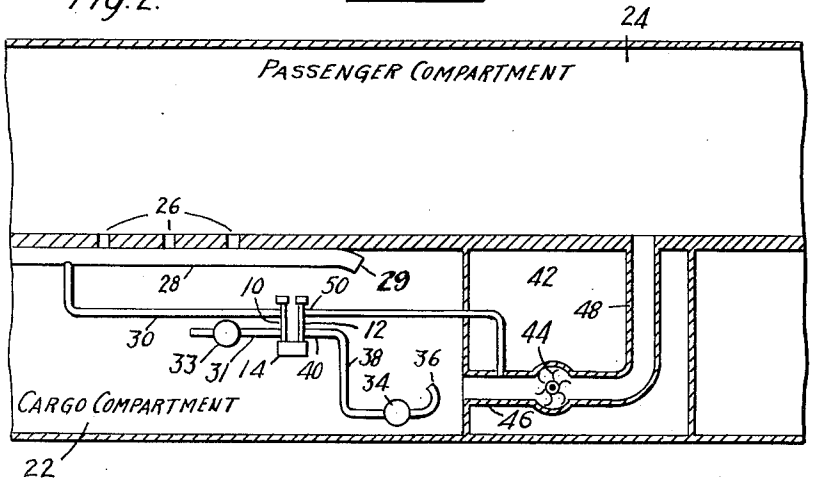
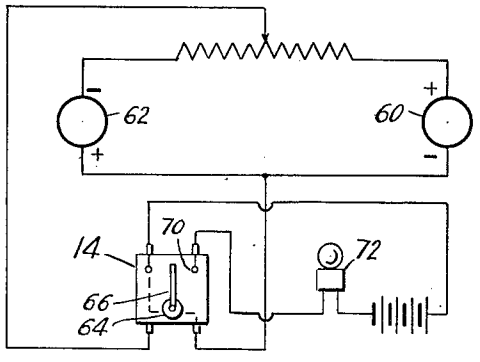


Fig. 3.



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DETECTION OF SUSPENDED MATTER IN GASES

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6 Claims. (Cl. 177—311)

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This invention relates to improvements in apparatus for detecting suspended matter in fluids.

While the present invention has many applications, it is particularly well adapted for the detection and comparison of smoke-laden air from different sources, whereby the presence of fire at its source can readily be detected and an alarm given. Accordingly, such application or adaptation of the invention will be referred to herein for convenience of description and illustration.

In smoke detecting apparatus, as is now well known, air is continuously drawn from the protected area or space to a smoke detecting cabinet where the presence of smoke in the air is detected by either or both visual and audible means. In such apparatus, a conduit leads directly from the protected area or space to the smoke detecting cabinet.

However, in some installations, the protected space receives air from another space or spaces, usually adjoining compartments, so that the air drawn from any one of those compartments to a smoke detecting cabinet is not representative of the air in that compartment, but is a combination or mixture of the air from the communicating compartments. Under such circumstances, it is impossible to determine the exact source of smoke. A specific illustration of such an installation is in aircraft where the ventilating system draws air from a passenger compartment to and through a cargo compartment. It is apparent that if passengers in the passenger compartment are smoking, the smoke will be drawn into the cargo compartment, thence through the conduit leading from the cargo compartment to the smoke detecting cabinet, causing false indication of fire in the cargo compartment with resultant confusion.

One of the objects of the present invention resides in the provision of apparatus whereby under such conditions as mentioned, the presence of smoke in the cargo compartment originating, by reason of passengers smoking in a communicating smoking compartment, will not of itself result in the giving of an alarm.

Another object of the present invention resides in the provision of means for giving an alarm when the density of smoke in a compartment exceeds that incident to tobacco smoke emitted by passengers in a communicating compartment.

Another object of the present invention resides in the sampling of air from communicating compartments or protected areas and comparing the density of the samples, whereby to determine, when smoke is present therein, whether the same is the result of fire or merely incidental to passengers smoking.

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A further object of the present invention resides in the provision of apparatus of the character indicated which readily can be installed and which may operate in conjunction with air circulating systems generally employed.

Further objects, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the accompanying drawing, wherein:

Figure 1 is a diagrammatic view of an apparatus for carrying out the present invention.

Figure 2 is a schematic fragmentary view of a fuselage of an airplane having apparatus in accordance with the present invention installed therein.

Figure 3 is a wiring diagram suitable for use with the present invention.

Referring to the drawing in detail, the apparatus illustrated in Figure 1 is a smoke detector of novel construction comprising a pair of hollow tubes 10 and 12, a housing 14 for a light source 16, mirrors 18 and 20 and other elements, as will be described presently.

This smoke detector is adapted to be mounted at a suitable location in a cargo compartment 22, as shown in Figure 2. As will be seen from Figure 2, the cargo compartment 22 is situated below a passenger compartment 24, the floor of which is provided with openings 26 leading to a duct 28 having an open end 29 extending into the cargo compartment 22. A conduit 30 leads from one end of the duct 28 to an inlet 32 of the tube 10 of the smoke detector. The tube 10 has an outlet conduit 31 provided with a suction fan 33 for drawing air from the duct 28 through the tube 10 by way of the inlet 32.

A blower 34 is mounted in the cargo compartment 22 adjacent the air outlet therefrom. This blower is provided with an inlet 36 whereby air is drawn from the compartment 22 and forced through a conduit 38 into the tube 12 of the smoke detector by way of inlet 40, thence through the tube and out by way of a conduit 50 into an exhaust conduit 46.

Adjacent to the cargo compartment 22 is another compartment 42 which houses equipment for maintaining the air in the passenger compartment under pressure. This equipment may be the conventional air recirculating equipment having a blower 44 which draws air from the

passenger compartment by way of duct 28 and outlet 29 into the cargo compartment 22 and through inlet conduit 46 of blower 44. The air drawn by the blower 44 from compartments 22 and 24, in the manner just described, may be passed to the atmosphere, or all or part of it may be cleaned, filtered and otherwise treated and then recirculated to the passenger compartment.

During operation of the air circulating system and the smoke detector, a sample of the passenger compartment air is continuously drawn through the tube, while a sample of the combined passenger and cargo compartment air is drawn through the tube 12. When conditions are normal in the cargo compartment, that is, no smoke is being generated therein due to a fire, the samples of air passing through the tubes 10 and 12 will be of the same quality.

The smoke detector automatically compares the density of suspended matter in the air in the tube 10 with that in the tube 12. This is accomplished by means of a normally balanced electrical bridge circuit including light sensitive elements and a galvanometer type relay as diagrammatically illustrated in Figure 3. The tubes 10 and 12 are each provided at one end with a photoelectric cell of the current generating type 60 and 62 respectively, and at their other ends with lenses 61 and 63 respectively, which are so mounted as to hermetically seal the ends of the tubes.

When no smoke is present in the tubes 10 and 12, light from the light source 16 is transmitted equally to the cells 60 and 62 by the mirrors 18 and 20, through the lenses 61 and 63 and tubes 10 and 12 respectively, and the bridge remains balanced. However, when smoke enters the tube 10 from the passenger compartment, the intensity of the light reaching the photoelectric cell 60 will be reduced, whereby the bridge will be unbalanced and current will flow in one direction through relay 64 enclosed in the housing 14, deflecting the needle 66 to the left, as viewed in Figure 3. When smoke, originating in the passenger compartment and passing into the cargo compartment by way of duct 28, passes from the cargo compartment 22 into the tube 12, the density of the smoke in each tube will be substantially equalized whereupon the needle will return to its normal position of balance as shown in Figure 3.

Should a fire occur in the cargo compartment the smoke enters the tube 12 and the intensity of the light reaching the cell 62 will be reduced to a greater extent than that of the light reaching the cell 60, whereby current will be caused to flow through the relay 64 in the opposite direction, which will result in the needle 66 being deflected to the right, as viewed in Figure 3, into engagement with contact 70 to close a circuit to the alarm 72.

It will be appreciated from the foregoing that when the smoke-laden air in the tube 10, received from the passenger compartment, is of the greater density, the needle 66 will be deflected to the left as viewed in Figure 3, and no alarm will be given, whereas when the density in the tube 12 is the greater, the needle will be deflected to the right and will close the alarm circuit.

It will be seen from the foregoing that should passengers in the passenger compartment be smoking, the smoke-laden air which is drawn into the cargo compartment will not of itself

operate the alarm, inasmuch as the smoke passing through the sampling conduit 30 and the tube 10 will be of greater density than the smoke passing directly to the cargo compartment out of the open end of the duct 28, the latter smoke being mixed with the air in the cargo compartment. However, when a fire develops in the cargo compartment, the smoke drawn through the tube 12 from the cargo compartment will be of greater density than the sample of smoke leaving the passenger compartment, so that there will be a comparison of the density of the smoke passing through the tubes 10 and 12, and when this comparison indicates that the smoke in the tube 12 is of the greater density then, and only then, will an alarm be given. It is to be understood that instead of an audible alarm as illustrated visual detection of any of the conventional types may be substituted if desired.

While I have illustrated and described a preferred embodiment of my invention, it is to be understood that I do not wish to be limited to the precise structure and arrangement illustrated and described, as obviously various changes and modifications may be made therein without departing from the spirit and scope of my invention.

I claim:

1. In a smoke detecting system, the combination of a pair of compartments one of which normally may contain smoke and the other of which is supervised to detect the generation of smoke therein due to a fire, means including a duct for exhausting air from the first mentioned compartment through the second mentioned compartment, means for withdrawing a sample of air from said first compartment, means for detecting the presence of smoke in the sample of air withdrawn from said first compartment, means for withdrawing a sample of air from said second compartment, means for detecting the presence of smoke in the sample of air withdrawn from said second compartment, and means for giving an indication when the density of the smoke in the sample withdrawn from said second compartment exceeds the density of the smoke in the sample withdrawn from said first compartment.

2. In an airplane smoke detecting system, the combination of a passenger compartment, a cargo compartment, means including a duct for exhausting air from the passenger compartment through the cargo compartment, means for withdrawing a sample of air from the passenger compartment, means for detecting the presence of smoke in the passenger compartment air, means for withdrawing a sample of air from the cargo compartment, means for detecting the presence of smoke in the cargo compartment air, and means for giving an indication when the density of smoke in the cargo compartment air exceeds the density of smoke in the passenger compartment air.

3. In an airplane having a passenger compartment, a cargo compartment and means for withdrawing air from the passenger compartment to the cargo compartment including an air duct leading from the passenger compartment to the cargo compartment, the combination of sampling means for receiving a sample of the air withdrawn from the passenger compartment, sampling means for receiving a sample of the air withdrawn from the cargo compartment, a light source, means for directing light rays from said source into said sampling means, a light

sensitive element associated with each of said sampling means and located in the path of said light rays, electrically operated means responsive to said elements, and a signal circuit adapted to be closed by said electrically operated means when the density of suspended matter in the air in a predetermined one of said sampling means exceeds the density of the suspended matter in the air in another of said sampling means sufficiently to set up a differential in the intensity of the light rays falling on said light sensitive elements.

4. In an apparatus for detecting the presence of fire in a compartment through the detection of smoke originating therein, which first named compartment is functionally in communication with a compartment in which smoke may be present, and which is subject to a flow of air from the second named compartment, the combination of a pair of receivers, means for withdrawing a sample of air from the first named compartment through one receiver, means for withdrawing a sample of air from the second named compartment through the other receiver, and means associated with the receivers for indicating an increase of density of smoke in the sample of air from the first named compartment over the density of smoke from the second named compartment due to the presence of fire in the first named compartment and the increased production of smoke therein.

5. In an apparatus for detecting the presence of fire in a compartment through the detection of smoke originating therein, which compartment is functionally in communication with a second compartment in which smoke may be present, and which first named compartment is subject to a flow of fluid from the second named compartment, the combination of means for withdrawing fluid from the second named compartment to the first named compartment to provide a mixture of the fluid of both compartments in the first named compartment, a pair of receivers, means for withdrawing a sample of the mixture of fluid from the first named compartment through one receiver, means for withdrawing a sample of fluid from the second named compartment through the other receiver, and means associated with the receivers for indicating an increase in the density of the fluid from the first named compartment over the density of fluid from the second named compartment due to the presence of fire in the first named compartment and the increased production of smoke therein.

6. In an apparatus for detecting the presence of fire in a compartment through the detection of smoke originating therein, which compartment is functionally in communication with a second compartment in which smoke may be present, and which first named compartment is subject to a flow of air from the second named compartment, the combination of a conduit leading from the second named compartment to the first named compartment, suction means for withdrawing air from the second named compartment to the first named compartment to provide a mixture of the air of both compartments in the first named compartment, a pair of receivers in said first named compartment, means for withdrawing a sample of the mixture of air from first named compartment through one receiver, means for withdrawing a sample of air from the second named compartment through the other receiver, and means associated with the receivers for indicating an increase of density of smoke in the sample of air from the first named compartment over the density of smoke from the second named compartment due to the presence of fire in the first named compartment and the increased production of smoke therein.

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