

April 20, 1943.

J. J. BLISS

2,317,024

FIRE ALARM APPARATUS

Filed April 22, 1940

2 Sheets-Sheet 1

Fig. 1

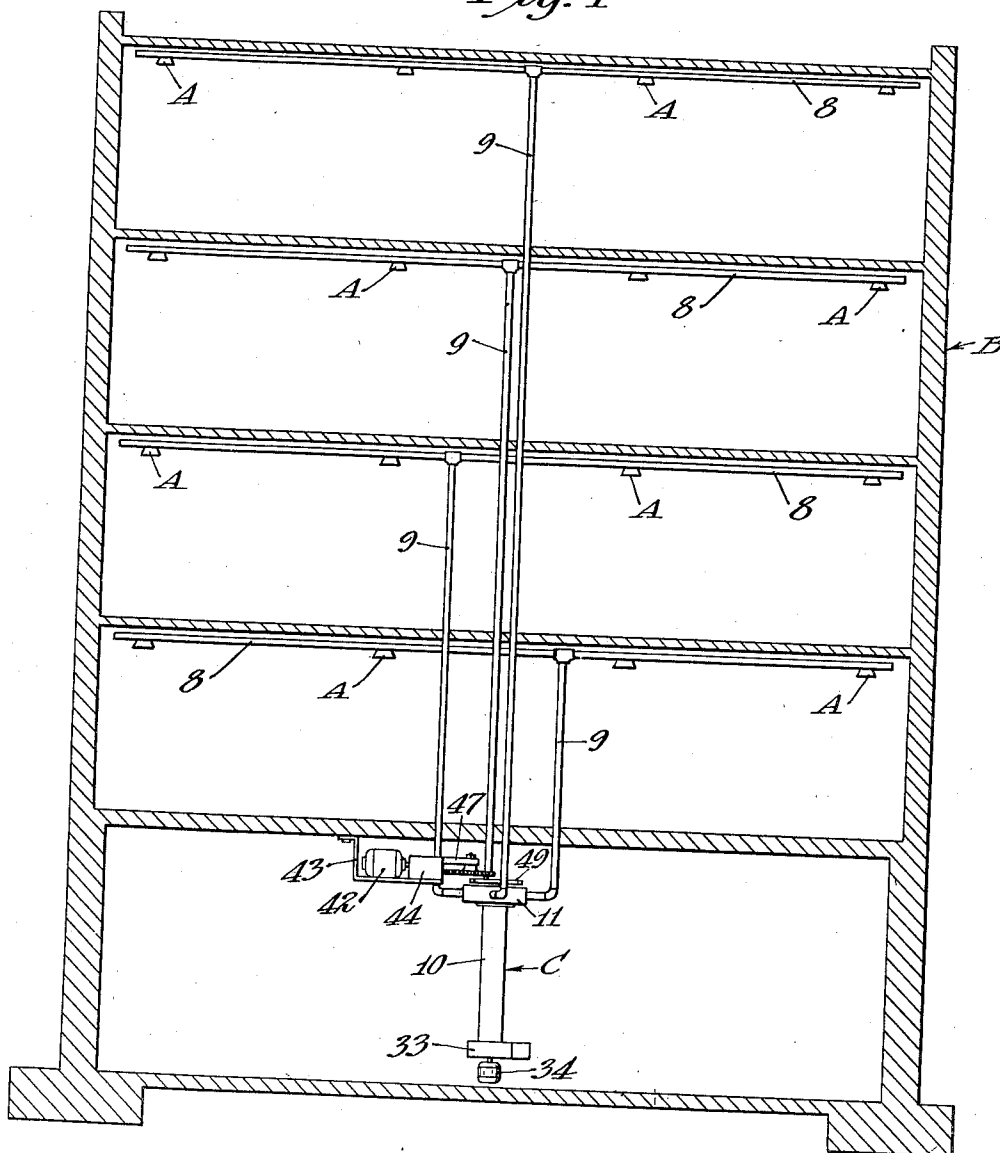
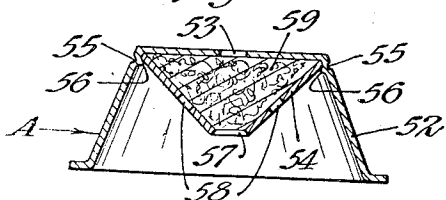


Fig. 7



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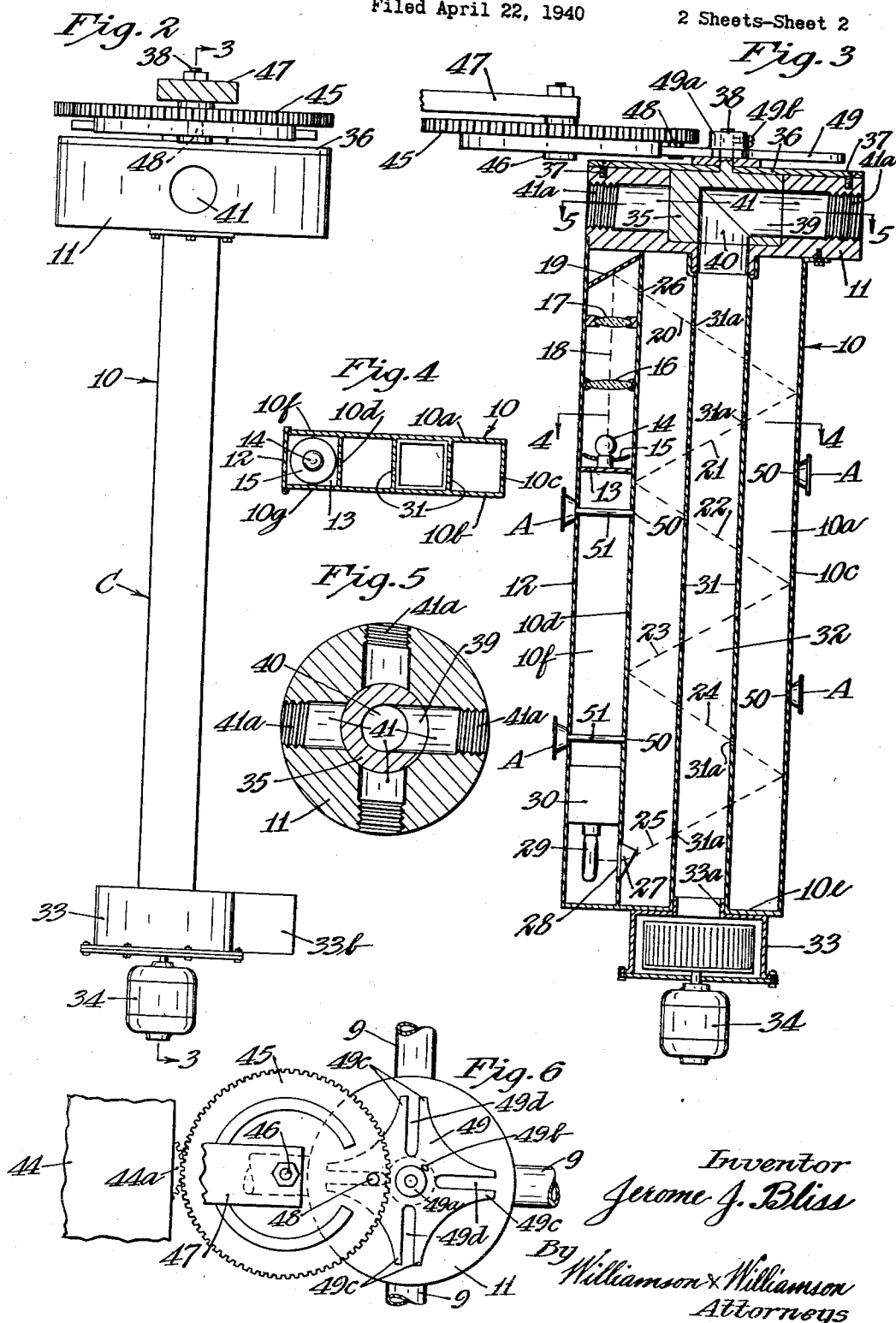
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UNITED STATES PATENT OFFICE

2,317,024

FIRE ALARM APPARATUS

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Application April 22, 1940, Serial No. 330,972

3 Claims. (Cl. 177—311)

My invention relates to electrical alarm apparatus such as fire alarm apparatus and particularly to such apparatus which operates on a smoke, dust or steam detection basis, utilizing the photo electric cell.

One object of my invention is to provide improved fire alarm apparatus of the photo-electric smoke detection type particularly adapted for protecting the various room spaces of buildings of considerable size.

Another object is to provide such apparatus which is particularly sensitive to the presence of a very small amount of smoke in sampled air passed through the apparatus.

Still another object is to provide such apparatus arranged for especially efficient sampling of air successively from respective portions of a building and for locating the particular portion of the building in which abnormal air conditions exist.

Another object is to provide such apparatus which, when used for fire alarm purposes, will eliminate false alarms which might occur through the presence of dust or steam in the sampled air.

Yet another object is to provide such apparatus of such construction that dust or the like in the sampled air will be effectively prevented from being deposited on elements of the optical system of the apparatus.

A further object is to provide such a system including filtering means for minimizing the amount of dust or the like which is drawn from protected rooms into the system.

A further object is to provide such apparatus of simple, compact, light, and inexpensive construction.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the same parts throughout the views, and, in which:

Fig. 1 is a vertical sectional view of a building having installed therein a fire alarm system constructed in accordance with the invention;

Fig. 2 is a side view of a smoke detection unit constituting an embodiment of the invention;

Fig. 3 is a vertical sectional view taken on the line 3—3 of Fig. 2, as indicated by the arrows;

Fig. 4 is a horizontal sectional view taken on the line 4—4 of Fig. 3, as indicated by the arrows;

Fig. 5 is a horizontal sectional view taken on the line 5—5 of Fig. 3, as indicated by the arrows;

Fig. 6 is a partial top view; and

Fig. 7 is a diametrical sectional view of an air filter unit constituting a part of the system.

Referring to the drawings and particularly to Fig. 1 a building B is shown having therein a system of piping connecting a plurality of air inlets equipped with filters A, which will be later described, to smoke detection apparatus C. Each floor of the building B is provided with a pipe 8 carrying filter equipped air inlets situated in various rooms of the building B. The pipes 8 of the respective floors of the building B are connected through respective other pipes 9 to the smoke detection apparatus C.

Broadly described, the smoke detection apparatus C includes a pair of parallel mutually facing light reflective surfaces, means projecting a beam of light on one of said surfaces near an end thereof at such an angle that the beam will be reflected alternately by the two light reflecting surfaces to follow a zigzag course therebetween toward the other end of the pair of light reflecting surfaces, alarm apparatus including and controlled by photo-electric cell situated to receive the multiple reflected light beam, and means for taking sampled air successively from the respective pipes 9 and passing this air longitudinally of the space between said reflecting surfaces so that the column of sampled air will intersect each successively reflected portion of the light beam.

In Figs. 2 to 6 inclusive I have illustrated one form in which apparatus conforming to the above general description may be made.

I provide a smoke detector casing 10 having longitudinal side walls 10a, 10b, 10c and 10d, a bottom wall 10e and a top wall 11 which constitutes the casing of a rotary valve to be described later. The walls 10c and 10d are disposed parallel to each other and have inner mutually facing surfaces prepared by suitable means so as to be light reflective to a relatively high degree. To the left of the casing 10 I provide extensions 10f and 10g of the side walls 10a and 10b and a closure 12 cooperating with the extensions 10f and 10g to form a compartment extending the full length of the casing 10. The bottom wall of the casing 10 is extended to cross the bottom end of the compartment so formed and a portion of the rotary valve casing 11 constitutes a closure for the upper end of the said compartment.

As indicated in Fig. 3, I provide somewhat above the middle of the above described compartment a horizontal partition 13 carrying on its upper side a light source such as the electric

lamp 14. The light source may be provided with a reflector 15 to direct rays upwardly. Above the light source 14 I provide lenses 16 and 17 for condensing the rays of light from the light source 14 into a relatively narrow upwardly described beam of light, the axis of which is represented by a line 18. Above the upper lens 17 I provide within said compartment an angularly disposed flat reflector 19 so positioned as to reflect the rays to follow a path having an axis represented by the line 20 and extending to the right and somewhat downwardly. After being so reflected the light beam will be reflected by the light reflective inner side of the casing wall 10c to follow a direction indicated by the line 21. The light beam will then be reflected by the light reflective inner surface of the casing wall 10d to follow a path whose axis is indicated by the line 22. This alternate reflection of the light beam by the light reflective inner surfaces of the casing walls 10c and 10d will be continued so that the light beam will follow a course indicated by lines 23, 24 and 25. The casing wall 10d is apertured at 26 to permit projection therethrough of the portion of the light beam indicated by the line 20. A prism 27 is mounted on the inner side of the casing wall 10d in such position as to receive the portion of the light beam indicated by the line 25 and is so arranged as to bend the light beam and direct the same horizontally to the left. The casing wall 10d is provided with an aperture 28 to permit passage therethrough of the light beam after it has been horizontally described by the prism 27. A photo-electric cell 29 which may be of conventional form is placed in the bottom end of the previously described compartment in such position as to receive the light beam after the same has been described by the prism 27. From the above it will be apparent that the light beam produced by the light source and the lenses 16 and 17 will follow a zigzag course downwardly through the interior of the casing 10 and will finally reach the photo-electric cell 29. Associated with the photo-electric cell 29 is alarm apparatus 30 which may be of any of the conventional forms now available on the market, and which is arranged to provide a signal or indication when the strength of the light beam has received in the photo-electric cell 29 is diminished to a value somewhat less than normal.

Means is provided for guiding sampled air through the interior of the casing 10 in such manner that the guided column of air will intersect each of the portions of the light beam indicated by the respective lines 20, 21, 22, 23, 24 and 25. For this purpose a pair of spaced partitions 31 are provided within the casing 10 and arranged to extend longitudinally thereof in spaced relation with the casing walls 10c and 10d so that the partitions 31 in cooperation with portions of the side walls 10a and 10b form a conducting duct having an interior space 32. The lower ends of the partitions 31 are suitably joined to the bottom wall 10e of the casing 10, and the upper ends of the partitions 31 are suitably joined with the valve casing 11 which constitutes the upper end wall of the casing 10. The partitions 31 are provided with a plurality of apertures 31a which are relatively small in size and each of which is situated at a point where the previously described light beam would otherwise strike the partitions 31. The apertures 31a enable the light beam to follow its previously described zigzag course without being interrupted by the partitions 31 and also enable the light

beam to cross the interior space 32 of the duct partly formed by the partitions 31. Thus when clear air is present in the interior 32 of the duct no diminution of the amount of light reaching the photo-electric cell 29 will occur, but when the air in the space 32 has an appreciable smoke content the smoke particles will interfere with passage of the light beam through the interior space 32 of the duct at each of the lines 20 to 25 which indicate the zigzag course of the light beam. It should be apparent that since the light beam must pass through the column of sampled air a number of times the amount of light delivered to the photo-electric cell 29 will be quite appreciably diminished by a relatively small smoke content in the air within the interior 32 of the duct.

Means is provided for causing the flow of sampled air from bodies of air in rooms subject to fire hazard through the interior space 32 of the duct. For inducing such a current of air I provide a suction blower 33 driven by an electric motor 34 and having an inlet element 33a telescopically connected with the lower end of the duct formed in part by the partitions 31. The blower has an air outlet element 33b which may be left open to discharge in the surrounding atmosphere.

While the upper end of the duct space 32 might readily be directly connected to a pipe, such as the pipe 9, I prefer to include means whereby it will be connected successively to respective ones of a plurality of pipes, such as the pipes 9. For this purpose I provide a rotary valve including a stationary housing or block 11 which is cylindrically apertured to receive a cylindrical rotatable valve element 35. The block 11 is apertured for receiving the rotary valve member 35 from the top so that the lower end of the rotary valve element 35 will rest upon an apertured portion of the block 11. A centrally apertured plate 36 is secured to the top of the block 11 by suitable means such as the screws 37 to retain the rotatable member 35 within the cylindrically apertured portion of the block 11. The rotatable valve element 35 is provided at its upper end with a centrally located operating shaft 38 which projects upwardly through the centrally apertured portion of the plate 36. The rotating valve member 35 is provided with a radial extending passage 39 in communication with an axially and downwardly extending passage 40 which is in registration and hence communicates with the upper end of the interior space 32 of the duct between the partitions 31. The block 11 is provided with a plurality of radially extending air inlet passages or ports 41 positioned to be successively in communication with the radial passage 39 of the rotary member 35 during rotation of the rotary member 35. The outer ends of the radial passages 41 in the block 11 may be provided with internal screw threads 41a for connection of the pipes 9 within block 11. Obviously rotation of the rotary valve member 35 with the suction blower 33 in operation will result in sampled air being drawn successively from the respective pipes 9 to pass downwardly through the interior space 32 of the smoke detecting unit.

I provide means for rotating the valve member 35 through successive angles in such a manner that the valve member 35 will be at rest for a period of time between each successive angular rotation and the next and will, during each period of rest, be so positioned that the radial passage 39 will be in registration with one of the

respective inlet passages 41. For this purpose we provide an electric motor 42 supported by a suitable bracket 43 and delivering rotative mechanical power through a gear reduction unit 44, which may be of conventional structure, to suitable intermittent rotary power transmission apparatus interposed between the gear reduction unit 44 and the shaft 38 of the rotatable valve member 35. This intermittent drive mechanism may be in the form of a Geneva movement as shown in Figs. 3 and 6. A gear 44a constituting part of the speed reduction gears of the gear box unit 44 is meshed with another gear 45 which is rotatably mounted on a pivot assembly 46 carried by an arm 47 mounted on the gear box 44. The gear 45 carries an eccentrically situated downwardly projecting pin 48 thereon, this pin constituting a portion of the Geneva movement. A Geneva wheel 49 is provided having a hub 49a non-rotatively secured on the shaft 38 by suitable means such as the set screw 49b. The Geneva wheel 49 in accordance with the usual construction of such wheels has a series of lobes 49c each of which has a radially extending outwardly opening notch 49d therein for receiving the pin 48. The operation of such a Geneva movement is quite commonly and well understood and hence it is believed unnecessary to describe its action. It should be apparent that operation of the motor 42 will result in the rotatable valve member 35 being quickly advanced from one angular position to another with periods of rest between successively angular advancements thereof. Thus it will be seen that a column of air is constantly passing downwardly through the interior space of the smoke detection duct and that this column of air will have successive portions drawn successively from the respective pipes 9 so that a constant check will be made on the possibility of smoke content in the air of the rooms on each and every floor of the building B.

I provide means for preventing dust, smoke or the like from passing through the apertures 31a and being deposited on the reflective inner surfaces of the casing walls 10c and 10d, the reflector 19, the lenses 16 and 17, the lamp 14, the reflector 15, the prism 27 or the photo-electric cell 29. For this purpose I provide air inlets 50 in the casing walls 10c and 10d, as indicated in Fig. 3 to admit small quantities of air into the interior of the casing 10 responsive to the suction of the blower 33. The admitted air will flow into the interior space 32 of the smoke detection duct through the apertures 31a and hence will prevent outward movement through the apertures 31a of dust, smoke or the like. The small inlet ports 50 are each provided with an air filter A for filtering the air entering at these points. To connect the filters A at the left-hand side of the device to the corresponding air inlet ports 50 I provide suitable pipes 51 extending through the interior space of the compartment in which the light source 14 and photo-electric cell 29 are housed.

The type of filter unit identified by the letter A in Figs. 1 and 3 is illustrated in Fig. 7. The filter unit includes a shallow inverted pan 52 having an aperture 53 centrally located in the upper portion thereof. The upper portion of the pan 52 may be soldered or otherwise secured to a pipe, such as the pipe 9, or to a wall, such as the wall 10c, with the aperture 53 in registration with a similar aperture in the pipe 9 or wall 10c. As shown in Fig. 7, a cone shaped member 54 is placed in inverted position in the interior of the

pan 52 so that the base of the cone is situated at the inner side of the upper portion of the pan 52. The cone 54 is held in place with the pan 52 by any suitable means as, for example, by making indents as at points 55 in Fig. 7 with a center punch or the like so as to produce projections 56 on the inner side of the pan abutting the base portion of the cone-shaped member 54. The cone-shaped member 54 is provided with an aperture 57 at its apex and other apertures 58 intermediate between its apex and its base, the apertures 57 and 58 being for the purpose of admitting air which will exit from the filter unit through the aperture 53. The space between the cone-shaped member 54 and the upper portion of the pan 52 is filled with a body 59 of filtering material. I prefer that the filtering material 59 be spun glass wool although various other kinds of material might be effectively used. It should be apparent that air drawn out of the aperture 53 will be drawn through the body 59 of filtering material and that this filtering material will extract from the air a major portion of the dust or other suspended materials which may have been present in the air.

From an inspection of Fig. 3 it should be obvious that the construction which causes the light beam to follow a zigzag course enables a considerable length of light beam to be subjected to the sampled air and yet permits a much more compact structure than if the light beam followed a simple straight path throughout its entire length. While for the purpose of simplicity I have shown the light beam striking the reflective inner surface of the wall 10c, at such an angle that relatively few successively reflected portions of the beam are produced it is believed apparent that in a practical device the angle may be so selected that a very great number of successively reflected portions of the light beam will be produced in a smoke detector casing of relatively short length. Also while I have shown a rotary valve arranged for association with only four pipes such as the pipes 9, it is entirely practical that the rotary valve be arranged for association with a much greater number of pipes such as the pipe 9.

It is apparent that we have invented a novel, compact, sensitive, effective, simple and inexpensive form of photo-electric type smoke detection and fire alarm apparatus.

While I have described the embodiment of the invention as it may be employed for use as a fire alarm device, it will be readily appreciated that by elimination of the filters A the device can be effectively used as an alarm device to measure the dust content, or the steam content in air taken from various rooms or spaces as from flour mills, cement plants, holds in vessels, or the like. It will also be understood that as used in the claims the words "smoke-detecting apparatus" are to be given a meaning sufficiently broad to cover the use of the apparatus for detecting dust content or steam content in the air.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. Smoke-detecting apparatus comprising, structure providing spaced, parallel, mutually facing, elongated light-reflective surfaces, a light source situated and arranged to project a beam of light on one of said surfaces near one end of

said pair thereof at such an angle that said beam will be reflected alternately by said respective surfaces to follow a zigzag course toward the remaining end of said pair, light-responsive means situated to receive said multiply reflected beam and arranged to cause production of a signal responsive to diminution of the strength of the received beam, an elongated duct positioned to intersect a plurality of the successively reflected portions of said beam, the walls of said duct being apertured at each intersection thereof with said beam to enable projection of said beam through said duct to cross the interior space thereof, and means for producing a flow of sampled air longitudinally through said duct and preventing contact of the sampled air with said light reflective surfaces.

2. Smoke-detecting apparatus comprising, an elongated casing having longitudinal walls including a pair of oppositely situated, flat, parallel ones thereof each having a light-reflective inner surface, a light source situated and arranged to project a beam of light on one of said surfaces near one end of said casing at such an angle that said beam will be reflected alternately by said respective surfaces to follow a zigzag course within said casing toward the remaining end thereof, light-responsive means near said remaining end situated to receive said beam and arranged to produce a signal responsive to diminution of the strength of the received beam, a duct extending within said casing longitudinally thereof in position to intersect a plurality of the successively reflected portions of said beam, the walls of said duct being apertured at each intersection thereof with said beam to enable projection of said beam through said duct to cross the interior space thereof, and suction-producing means connected to one end of said duct, the remaining end of said duct being adapted to be

placed in communication with a body of air to be sampled for smoke-detection purposes, and the walls of said casing being provided with a plurality of spaced and relatively small air inlet apertures whereby sampled air is prevented from coming into contact with said light reflective surfaces.

3. Smoke-detecting apparatus comprising an elongated casing having end walls and side walls of which a pair of oppositely situated side walls are disposed in parallel relation and are provided with light-reflective inner surfaces, a light source situated and arranged to project a beam of light on one of said surfaces near one end of said casing at such an angle that said beam will be reflected alternately by said respective surfaces to follow a zigzag course toward the remaining end of said casing, light-responsive means situated to receive said multiply reflected beam and arranged to cause production of an indication responsive to diminution of the strength of the received beam, a pair of spaced parallel partitions extending longitudinally of the interior of said casing intermediate of said surfaces to form a duct between said partitions, said end walls of the casing being apertured to provide an inlet and an outlet for said duct, said partitions each being apertured at each intersection thereof with said beam so that said beam will extend through said duct to cross the interior space thereof in each successively reflected portion of said beam, the inlet of said duct being adapted for being placed in communication with a body of air to be sampled for smoke-detection purposes, and means for producing a flow of air through said duct from the inlet to the outlet thereof and means permitting the entrance of air into the spaces between the side walls of said casing and said partitions.

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