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Aug. 15, 1944. I. H. McMANN 2,355,664

FIRE CONTROL APPARATUS

Filed Aug. 16, 1940 2 Sheets-Sheet 1

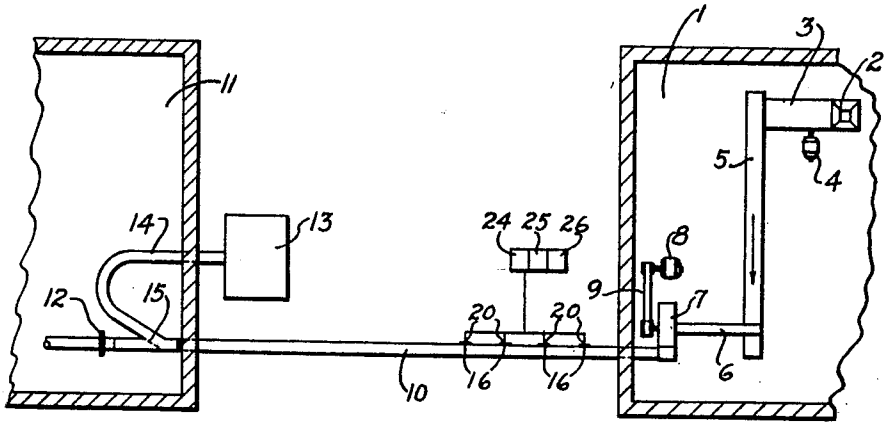


FIG. 1.

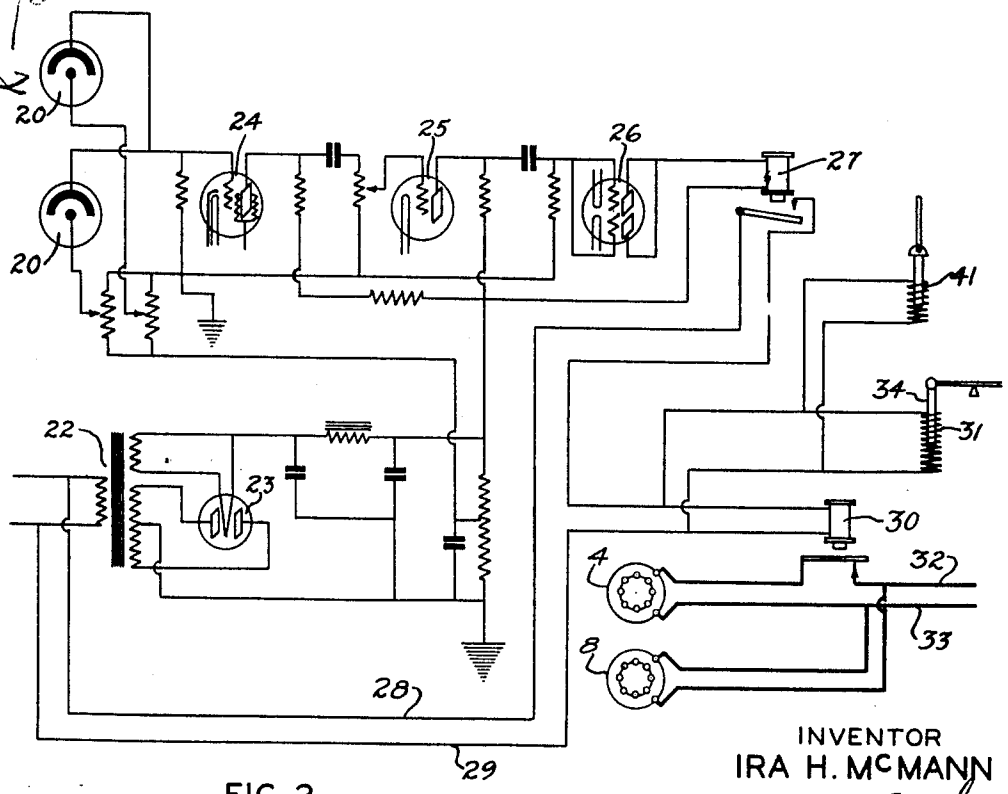


FIG. 2.

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Filed Aug. 16, 1940 2 Sheets-Sheet 2

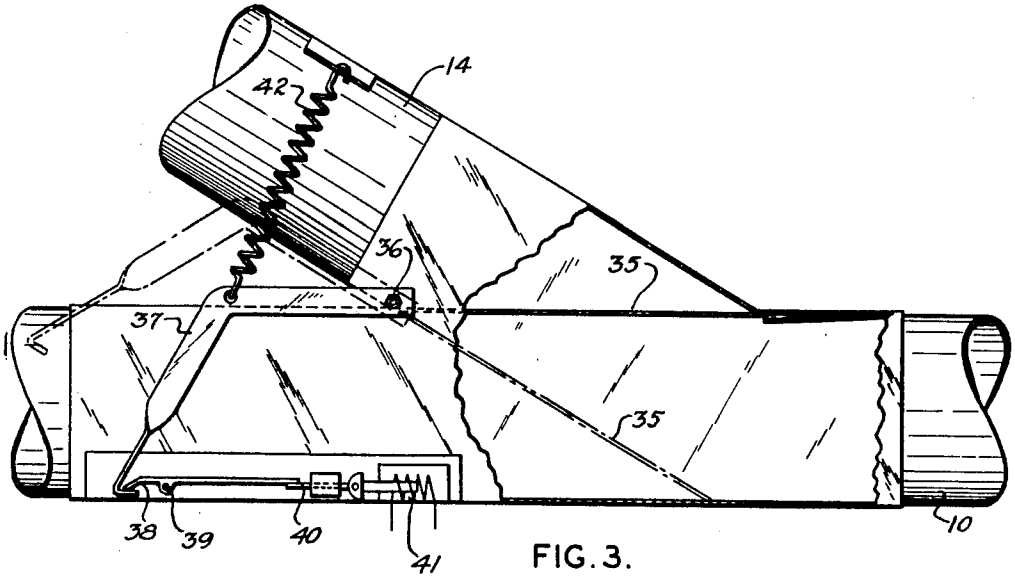


FIG. 3.

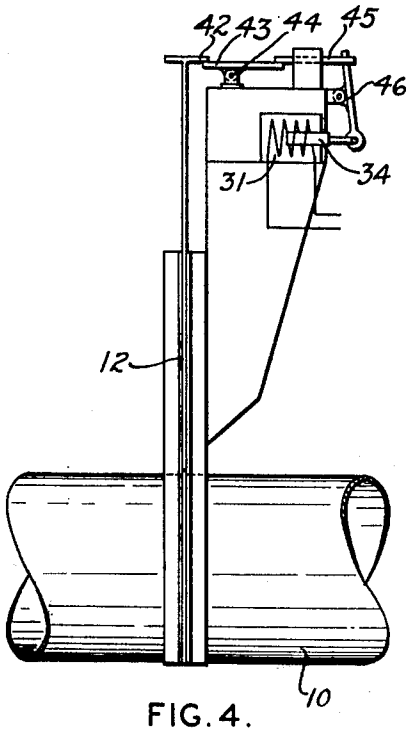


FIG. 4.

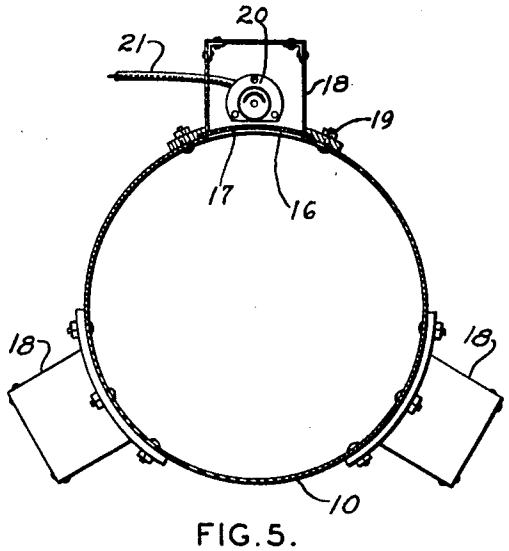


FIG. 5.

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Search Room

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UNITED STATES PATENT OFFICE

2,355,664

FIRE CONTROL APPARATUS

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Application August 16, 1940, Serial No. 352,932

9 Claims. (Cl. 169—2)

This invention relates, generally, to fire detecting and arresting apparatus, and particularly to such apparatus as is adapted to detect and arrest fires in ducts through which inflammable material is transmitted in air suspension.

In many industries, such for example as the textile industry, finely divided inflammable materials are transmitted from point to point in a stream of air, through suitably arranged ducts. For example, in the textile industry, particles of the textile material, such as cotton or rayon, are transmitted, at certain stages of the operations, by a stream of air through suitably arranged ducts. Such ducts may originate in one room or building, and extend to another room or building, into the latter of which the material is delivered. Since a fan or blower is employed in connection with such means for transporting the inflammable material, sparks not infrequently occur in the fan or blower, due either to mechanical defects or the presence of foreign substances; and in such cases the inflammable material in the stream of air is ignited, with the result that the flame is immediately transmitted to the room or building at the delivery end of the duct.

An object of the present invention, generally stated, is to provide an apparatus for detecting the presence of flame in ducts for transmitting inflammable material, and for setting in motion suitable apparatus for arresting the fire.

A further object of the invention is to provide a fire detecting organization so constructed and arranged as to detect incipient fires in rapidly moving streams of inflammable material.

Other objects will become apparent to those skilled in the art when the following description is read in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatic view illustrating the application of the apparatus of the present invention in the conventional duct for transmitting cotton fibres from the opening room to the picker room of a cotton mill.

Figure 2 is a wiring diagram of the electrical apparatus employed in connection with the fire detecting and arresting apparatus of the present invention.

Figure 3 is a detail view of a diverting switch employed in the cotton duct in connection with the embodiment of the present invention, as illustrated in Figure 1.

Figure 4 is a detail view showing arrangement of the fire door in a cotton duct, and suitable control apparatus therefor.

Figure 5 is a detail view, showing the arrangement of photo-electric cells in connection with the cotton duct.

In accordance with the present invention, generally stated, the tube or duct through which inflammable materials are transported in a stream of air or other gas may be provided with a window or series of windows at spaced intervals throughout its length, and so arranged that light originating on the interior of the duct may be detected by a photo-electric cell or other light detecting means, arranged on the exterior of the duct. In the detection of fires in such ducts as are employed in cotton mills, however, the incipient stage of the fire exists when one or more, but a limited number, of fibers have become ignited, and in such condition only a vestige of light is emitted by the fire in this incipient stage. The quantity of light emitted by a fire which has progressed no farther than a few particles of inflammable material, such as cotton or rayon, is not sufficient to so energize an ordinary photo-electric cell that the photo-electric cell may be depended upon to actuate electrical or mechanical means for arresting the fire, and consequently, in order to arrest the fire in its incipient stage, the present invention contemplates the provision of amplifying means for amplifying the current delivered by a photo-electric cell which detects the presence of flame, to a sufficient extent to permit that current to actuate a relay which, in turn, effects a closure of the duct at or near the delivery end thereof, and interrupts the flow of the air stream conveying the inflammable material.

The present invention further contemplates the provision of means whereby the stream of ignited material travelling through the duct is diverted into a suitable fire-proof chamber, which may be equipped with automatic sprinklers and other desirable fire control devices for extinguishing the flame, without immediately interrupting the supply of air to the duct, thereby permitting the fire in the duct to burn itself out, and thereby avoiding accumulation of ash in the duct, such as would result if the flow of combustibles were arrested immediately upon detection of the fire. The flow of material through the duct is therefore, desirably continued for a brief period after the stream has been diverted. Diversion, as distinguished from damming the stream, avoids the building up of excessive pressure within the duct.

While the invention will be described with particular reference to the application thereof to cotton mills, it is to be distinctly understood that

the invention is not limited to cotton mills, or even to the textile industry; but that the features thereof are applicable at large to many industrial applications of the transportation system wherein a stream of inflammable material is transported in air suspension; and such reference as is herein made to cotton mills, cotton ducts, and other conventional apparatus employed in the textile industry are by way of illustration, and not by way of limitation.

Referring now to the drawings for an illustrative embodiment of the present invention, the usual opening room of a cotton mill is diagrammatically shown at 1. Provided in the opening room is a hopper 2 into which the fibrous cotton is fed. Materials deposited in hopper 2 are forced through a chute 3 by an electric motor 4, in a manner well known to those skilled in the art, and are discharged upon a conveyor 5 which operates in the direction indicated by the arrow. At the opposite end of the conveyor 5 is a suction tube 6, associated with a suitable blower 7, and arranged to suck the cotton fibers from conveyor 5 through tube 6.

Blower 7 is driven by an electric motor 8 through a suitably arranged belt and pulley combination 9, or otherwise, as desired.

A duct 10 extends from the delivery end of blower 7 to another enclosure 11, commonly called the picker room, in a cotton mill; and the material thus transported through duct 10 is discharged into the picker room 11.

In accordance with the present invention, a fire door 12 is provided adjacent the discharge end of duct 10, and arranged to be held normally open but by mechanism hereinafter described in detail, the fire door 12 is arranged to be closed upon the detection of light in duct 10.

In the embodiment illustrated in the drawings, provision is made for by-passing the ignited stream of material to a fire proof chamber 13 after fire door 12 has become closed. Accordingly, an auxiliary duct 14 extends from duct 10, being arranged immediately adjacent fire door 12, but on the blower side thereof, and terminates in fire proof chamber 13. The fire proof chamber 13 may be provided with automatic sprinklers, or with other fire control devices well known to those skilled in the art. At the juncture between duct 10 and auxiliary duct 14, a switch 15 is provided. The switch 15, when in normal position, closes the mouth of auxiliary duct 14, but is arranged, in connection with the mechanism to be described in detail hereinafter, to open the mouth of duct 14 upon the detection of an incipient fire in duct 10.

In spaced relation lengthwise of duct 10 is a series of windows 16, four of which are shown in the embodiment illustrated in Figure 1, but any number of which, preferably more than one, may be provided. It is desirable to provide two such windows in angular displacement to each other, preferably at about 120° as near the blower 7 as is feasible, for the reason that fires in duct 10 invariably result from a force such as a spark set into action at blower 7; and a special feature of the present invention is the detection of such fires in their incipient stages, which dictates that the fire detecting means should be arranged as close as possible to the mechanism in which the fire is most likely to be initiated, namely blower 7.

Referring now to Figure 5 of the drawings, it will be observed that the duct 10 is provided with a series of windows 16 in substantially 120° angular displacement from each other. With this arrangement of windows, ignited particles of material in duct 10 may be detected, regardless of the position of the same in duct 10. That is to say, no portion of the interior of duct 10 is blinded by the walls thereof, and if an ignited particle should repose in a position so that it would not be detected at one window 16, it would be detected at the other window. Such arrangement of at least two windows 16 in approximately 120° angular displacement permits an adequate vista through windows of limited area, but it will be understood that equivalent results could be obtained by the employment of a single window extending for nearly 180° of the circumference of the duct.

The window openings 16 in the duct 10 are closed by a pane of glass or other transparent material 17, and a housing 18 is provided thereover, suitably connected to duct 10 as by rivets 19. Within the housing 19 is a photo-electric cell 20, arranged so as to receive light impulses from the interior of duct 10 through pane 17. Extending from photo-electric cell 20 is a cable 21, which is connected into the circuit now to be described, it being understood that the photo-electric cells at each of windows 16 are connected in parallel circuit relation to each other.

Referring now to Figure 2 of the drawings, the electrical circuits controlled by the photo-electric cells 20 will be described. As pointed out hereinbefore, the quantum of light emitted by one or a few cotton fibers, when the fire in the duct 10 is in its incipient stage, is insufficient to actuate an ordinary photo-electric cell to an extent such as to to set in motion the fire control devices of the present invention, and consequently the present invention especially contemplates that the photo-electric cell current be amplified. In order to accomplish this, an alternating current power supply is connected with a transformer 22, which in turn has its secondary connected in a conventional manner, so as to supply oscillating power to the photo-electric cells 20. In the circuit shown in the drawings, which is for illustration only, a thermionic full wave rectifier 23 is employed. The oscillating power is impressed upon the bank of photo-electric cells 20, any number of which may be provided, one for each window 16 in duct 10; and the photo-electric cells are connected in parallel, so that light detected by any one of them will be converted into an electrical impulse sufficient to set in motion the control devices of the present invention. In the circuit shown in Figure 2, three stages of amplification are provided by a series of amplifiers 24, 25, and 26, so that the electrical impulses resulting from the detection of a modicum of light by any one of photo-electric cells 20 is amplified, and as amplified, impressed upon a relay 27. In the embodiment shown in the drawings, the amplifier 24 is a pentode, the amplifier 25 is a triode, and the amplifier 26 is a double triode with its elements connected in parallel. Obviously, any other arrangement of specific types of amplifiers well known to those skilled in the art may be employed, and any desired number of amplification stages may be provided, so long as the slight electrical impulses delivered by photo-electric cells 20 are sufficiently amplified to energize and actuate relay 27.

Relay 27 is arranged to open and close a control power circuit comprising conductors 28 and 29, being arranged as shown to make and break the connection through conductor 28. Connected in parallel circuit relation across conductors 28

Search Room

and 29, so as to be controlled by relay 27, is a relay 30, a solenoid 31, and a solenoid 41.

Relay 30 is arranged, when energized, so as to break a power circuit extending from a suitable source of power through conductors 32 and 33 to the motor 4, which, as hereinbefore described, operates to feed material from hopper 2 to conveyor 5. Accordingly, when the system is operating normally, relay 30 is de-energized and the circuit through conductors 32 and 33 to motor 4 is complete; but upon detection of a fire in duct 10, relay 30 becomes energized and the circuit through conductor 32 to motor 4 is interrupted.

Solenoid 31 is arranged to actuate an armature 34 which in turn controls fire door 12. Solenoid 41 is arranged to actuate mechanisms which in turn control the position of switch 15. When the system is operating normally, solenoid 31 and solenoid 41 are de-energized so that fire door 12 is open and switch 15 is in a position such as to close the mouth of auxiliary duct 14; but upon detection of a fire, solenoids 31 and 41 become energized, so that fire door 12 is closed and switch 15 is actuated to open the mouth of auxiliary duct 14.

A convenient arrangement for operating the switch 15 is shown in Figure 3. In the embodiment shown, a door 35 is fixedly mounted upon a hinge pin 36, and arranged for movement between the position shown in full lines and the position shown in broken lines. In the position shown in full lines, the door 35 completely closes the mouth of tube 14; but when in the position shown in broken lines, the door 35 closes tube 10, and thereby diverts the stream of material through auxiliary duct 14.

In order to effect immediate actuation of door 35 upon the detection of a fire within duct 10, a crank 37 may be fixed upon pin 36 and associated with a latch 38 pivotally mounted at 39. The latch 38 is maintained in the position shown under normal conditions, by a dog 40 connected with the solenoid 41, connected to a suitable source of electric power, as described hereinbefore, and arranged to be energized upon detection of a fire within duct 10.

When crank 37 is in the position shown in full lines in Figure 3 (with door 35 closing the mouth of auxiliary duct 14) a spring 42 is under tension, so that upon release of dog 40 upon energization of solenoid 41, spring 42 is active upon crank 37 to move the latter into the broken line position, and thereby effect diversion of the stream of material from duct 10 to auxiliary duct 14.

As clearly shown in Figure 4, fire door 12 is provided with a shoulder 42 beneath which a latch 43 is arranged to engage when the fire door 12 is in its open position, as shown. Latch 43 is pivotally mounted upon a pin 44, and maintained in horizontal position by a slide 45 connected through a lever 46 with armature 34 of solenoid 31. When the solenoid 31 is energized, the armature 34 is moved to the left as shown in Figure 4, releasing slide 45 from latch 43 and permitting the latter to rotate about pin 44 so as to release fire door 12. The force of gravity is ordinarily sufficient to move fire door 12 into the position whereat its closes the passage through duct 10, but the action of gravity may, of course, be implemented by the arrangement of suitable springs.

From the foregoing description, it should be apparent that the present invention accomplishes its object, and provides a means of detecting and controlling fires in conveying systems where inflammable materials are conducted in a stream of air or other gas. In normal operation, the material is mechanically fed by motor 4 from a hopper 2 to conveyor 5. The material is picked up from conveyor 5 by the force of suction exerted by blower 7, and is forced through duct 10, and discharged into picker room 11. When, however, one or more of the photo-electric cells 20 detects the presence of light within duct 10, the electrical impulse delivered by the photo-electric cell or cells so energized is amplified and impressed upon relay 27, thereby completing a circuit from a source of power to relay 30 and solenoid 31, energizing and actuating the latter. Actuation of relay 30 interrupts the supply of power to motor 4, and consequently interrupts the supply of material from hopper 2 to conveyor 5. The motor 8, however, continues to operate, as it is not affected by the action of relay 30. Simultaneously with the interruption of power to motor 4, the mechanism controlling fire door 12 and switch 15 is actuated so as to close the former, and move the latter to a position whereat the mouth of auxiliary duct 14 is opened. During this stage, motor 8 having continued to operate, the fan 7 continues to operate, with the result that the stream of inflammable material suspended in air continues temporarily, but is diverted from picker room 11 to fire proof chamber 13. When the supply of material which was upon conveyor 5 (before the interruption of power to motor 4) has been exhausted, no further combustible material will be fed to duct 10 by blower 7, but the stream of air will continue, thereby blowing out duct 10 and cleaning the same of any residual ash from the fire. The provision of means so arranged as to continue the flow of air through duct 10, after the fire has been detected, but to divert the flow to a fire proof chamber, has therefore the special advantage that the duct is automatically cleaned, and at the same time excessive pressures in the duct are avoided. After the material in duct 10 has been permitted to burn itself out, operation of blower 7 may be interrupted manually by a suitable switch, not shown, all the mechanism then restored to its normal operating position, and operation begun anew.

While the foregoing disclosure of the invention has been made with particular reference to employment thereof in cotton mills, it is not to be understood that the invention is to be limited to such application, or to application in the textile industry. On the contrary, the features of the present invention are equally adaptable to any system wherein inflammable or combustible materials are transmitted in a stream of gas. It is obvious, of course, that many variations, modifications, and alterations in the speccific elements and arrangement thereof will suggest themselves to those skilled in the art without departing from the spirit of this invention, and it is therefore to be distinctly understood that the foregoing specific descriptions, and the illustration of specific embodiments in the drawings, are by way of illustration and not by way of limitation. Such modifications and adaptations, and the use of such individual features and combinations of features as present themselves to those skilled in the art without departing from the spirit of the invention are, although not specifically described herein, con-

templated by and within the scope of the appended claims.

Having thus described the invention, what is claimed is:

1. The combination with a tube for pneumatically conveying combustible materials, of fire control apparatus, comprising, a light sensitive device arranged to receive light rays emanating from burning material within the tube, and means responsive to said light sensitive device for diverting the material in the tube from its normal path toward a point where it is no longer dangerous.

2. The combination with a tube for pneumatically conveying combustible materials of fire control apparatus, comprising, a fire door in said tube, a diverting tube connected with said tube ahead of said fire door, said diverting tube leading to a point where burning material is no longer dangerous, a photoelectric cell arranged adjacent a window in said tube ahead of said fire door and diverting tube, and means responsive to energization of said photo-electric cell to close said fire door and open said diverting tube.

3. The combination with a tube for pneumatically conveying combustible materials, of fire control apparatus, comprising, a diverting tube connected with said tube, said diverting tube leading to a point where burning material is no longer dangerous, a photo-electric cell arranged adjacent a window in said tube ahead of said diverting tube, and means responsive to energization of said photo-electric cell to open said diverting tube.

4. In an apparatus for pneumatically conveying combustible materials, a conveying tube, means for circulating gas through said tube, means for feeding material to the intake end of said tube, a photo-electric cell arranged to be energized by burning particles within the tube, and means responsive to said photo-electric cell to interrupt the feed of material to said tube without interrupting said means for circulating gas.

5. In an apparatus for pneumatically conveying combustible materials, a conveying tube, means for circulating gas through said tube, means for feeding material to the intake end of said tube, a fire door arranged to interrupt the flow of materials through said tube, a photo-electric cell arranged to be energized by burning particles within the tube, and means responsive to said photo-electric cell to interrupt the feed of material to said tube and close said fire door without interrupting said means for circulating gas.

6. In an apparatus for pneumatically conveying combustible materials, a conveying tube, means for circulating gas through said tube, said auxiliary duct leading to a point where burning material is no longer dangerous, means for feeding material to the intake end of said tube, an auxiliary duct arranged for selective connection with said tube, a photo-electric cell arranged to be energized by burning particles within the tube, and means responsive to said photo-electric cell to interrupt the feed of material to said tube and connect said auxiliary duct without interrupting said means for circulating gas.

7. In an apparatus for pneumatically conveying combustible materials, a conveying tube, means for circulating gas through said tube, means for feeding material to the intake end of said tube, a fire door arranged to interrupt the flow of materials through said tube, an auxiliary tube arranged for selective connection with said tube ahead of said fire door, said auxiliary duct leading to a point where burning material is no longer dangerous, a photo-electric cell arranged to be energized by burning particles within the tube, and means responsive to said photo-electric cell to interrupt the feed of material to said tube to close said fire door and connect said auxiliary duct without interrupting said means for circulating gas.

8. In an apparatus for pneumatically conveying combustible materials, a conveying tube, means for circulating gas through said tube, means for feeding material to the intake end of said tube, an auxiliary duct arranged for selective connection with said tube, a fire proof chamber connected with said auxiliary duct, a photo-electric cell arranged to be energized by burning particles within the tube, and means responsive to said photo-electric cell to interrupt the feed of material to said tube and divert the flow of material through said tube to said fire proof chamber without interrupting said means for circulating gas.

9. In an apparatus for pneumatically conveying combustible materials, a substantially cylindrical conveying tube, means for circulating gas through said tube, means for feeding material to the intake end of said tube, an auxiliary duct arranged for selective connection with said tube, a fire proof chamber connected with said auxiliary duct, a series of light sensitive devices arranged at substantially 120° displacement from each other about said tube, said light sensitive devices being connected in parallel circuit relation with each other, a power amplifying circuit connected in series with said bank of light sensitive devices, and control means arranged to be actuated upon energization of either of said light sensitive devices to interrupt the feed of material to said tube and divert the flow of material through said tube to said fire proof chamber without interrupting said means for circulating gas.

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169-2

CERTIFICATE OF CORRECTION.

Patent No. 2,355,664. August 15, 1944.

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It is hereby certified that error appears in the printed specificatior of the above numbered patent requiring correction as follows: Page 3, first column, line 70, for "its" read --it--; page 4, first column, line 59, and second column, line 1, claim 6, strike out the words and comma "said auxiliary duct leading to a point where burning material is no longer dangerous," and insert the same after "tube,", page 4, second column, line 4; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of October, A. D. 1944.

Henry Van Arsdale

(Seal) Acting Commissioner of Patents.