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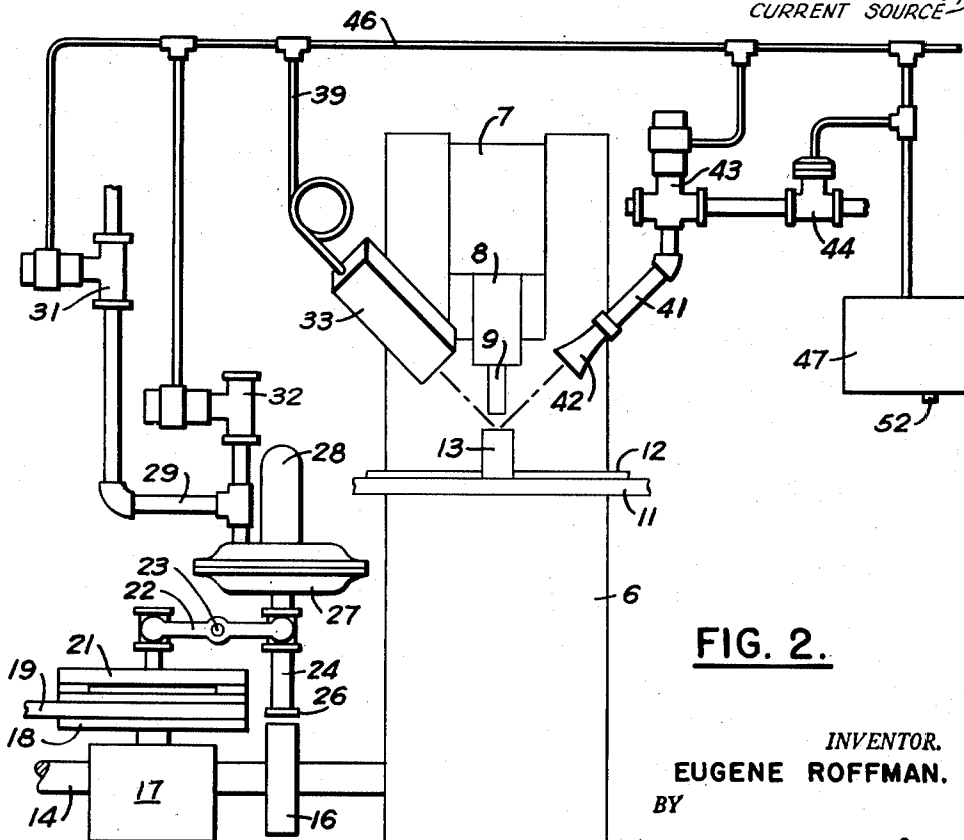
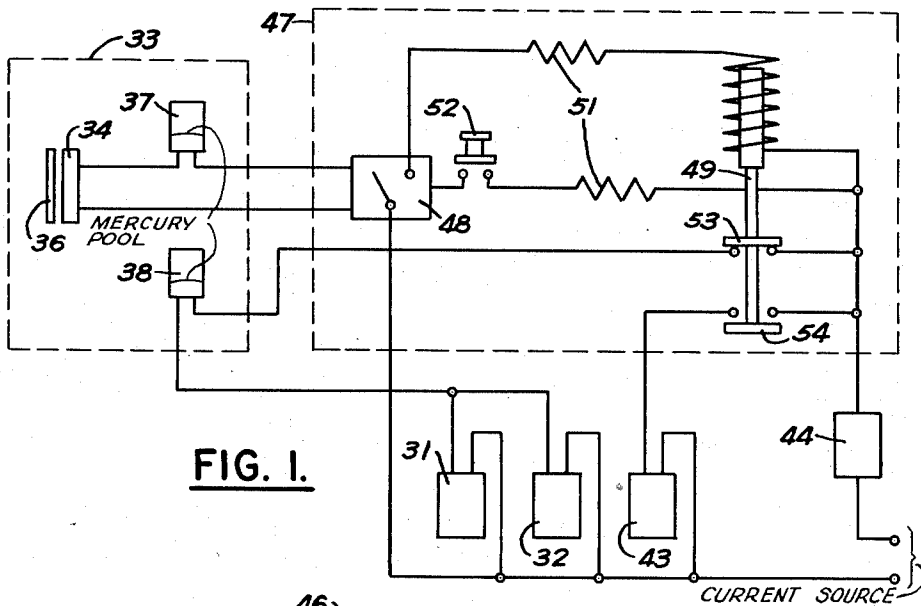
E. ROFFMAN

2,570,280

AUTOMATIC FIRE DETECTING AND EXTINGUISHING APPARATUS

Filed April 26, 1951

2 Sheets-Sheet 1



INVENTOR.
EUGENE ROFFMAN.
BY

H. J. Kessenich & J. H. Church
ATTORNEYS.

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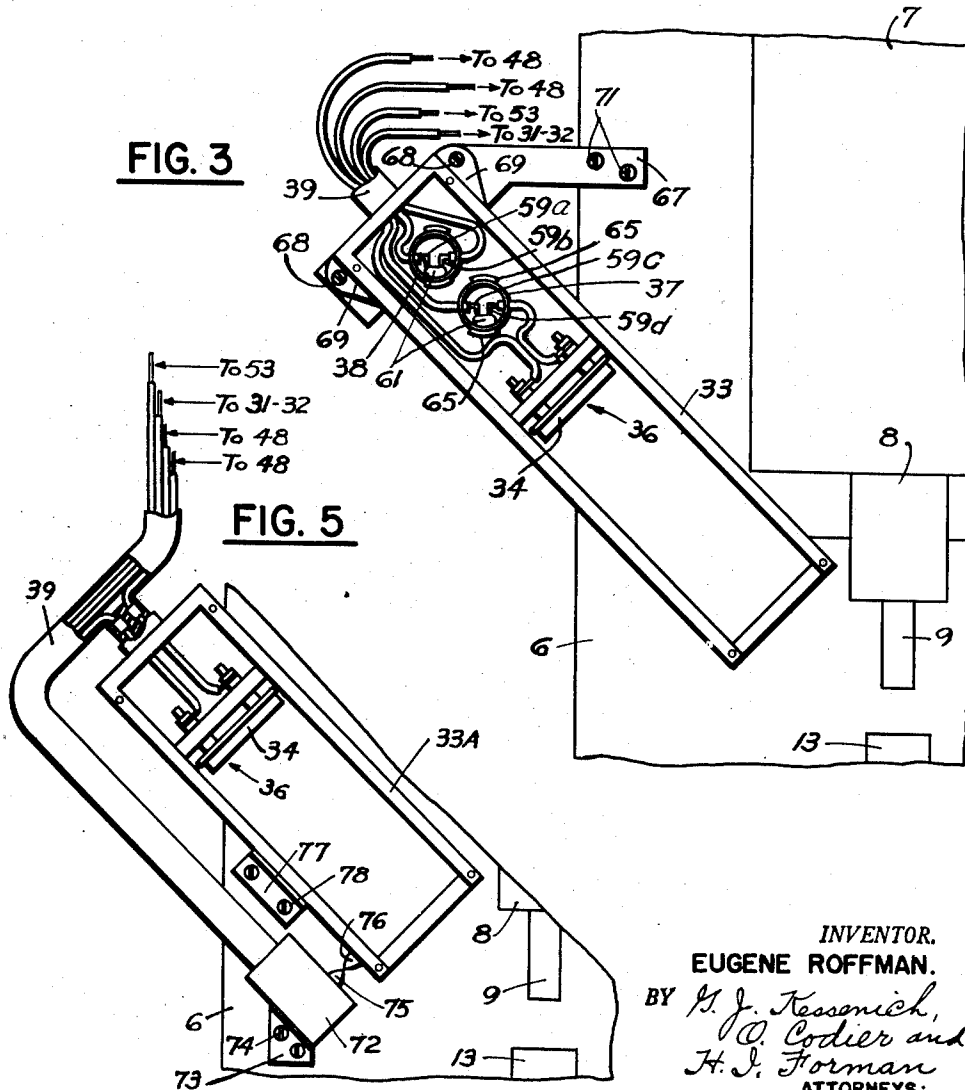
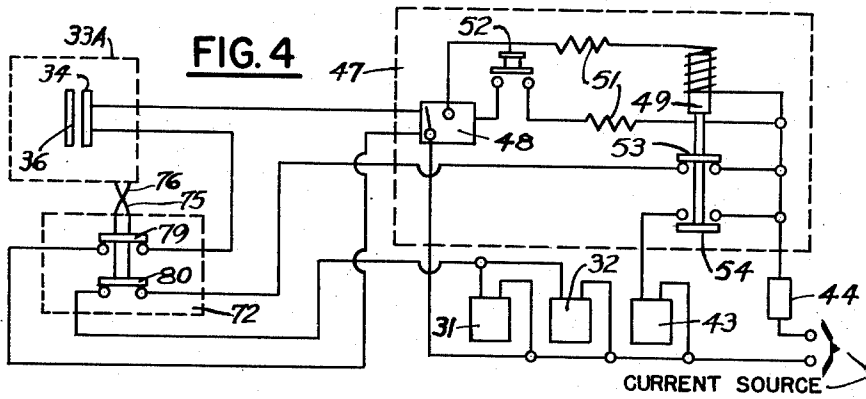
E. ROFFMAN

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AUTOMATIC FIRE DETECTING AND EXTINGUISHING APPARATUS

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2 Sheets-Sheet 2



INVENTOR.
EUGENE ROFFMAN.
BY *H. J. Kessenich,*
O. Codier and
H. J. Forman
ATTORNEYS:

UNITED STATES PATENT OFFICE

2,570,280

AUTOMATIC FIRE-DETECTING AND
EXTINGUISHING APPARATUS

Eugene Roffman, Philadelphia, Pa.

Application April 26, 1951, Serial No. 223,131

5 Claims. (Cl. 169—2)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

This application is a continuation-in-part of application Serial No. 144,557 which I filed on February 16, 1950 for "Automatic Fire Detecting and Extinguishing Apparatus," but which I have now abandoned.

My invention relates to fire extinguishing devices and has particular reference to apparatus for automatically detecting and extinguishing fires in machinery.

Broadly stated the object of my invention is to provide a device which will detect fires in machinery and almost simultaneously stop the machine's operation while deluging the area with a fire extinguishing medium, and which also will prevent operation of the machine until all the elements necessary to such protective action are in condition properly to function.

A more specific object of my invention is to provide a device which detects fire by photo-sensitive means and through various linkages stops the machine's operation and floods the fire with water or other extinguishing fluid.

Another object is to provide such a device which will permit the photo-sensitive device to be moved so that workmen will have free access to the machine for purposes of repairing, etc., but yet prevent operation of the machine until the photo-sensitive means is trained on the machine and the braking mechanism is in readiness.

A further object is to assure that when the photo-sensitive means is moved the fire detection and extinguishing apparatus will not be activated by virtue of light from a source other than the potential fire hazard striking the photo-sensitive detector.

Still another object is to provide such apparatus which is relatively inexpensive and which may be readily adapted for use in most machines wherein fires are likely to occur.

My invention will best be understood by reference to the illustrative embodiments shown in the accompanying drawings, wherein:

Fig. 1 is a diagrammatic view of the various elements, controls and wiring relationships of one form of my device;

Fig. 2 is a schematic illustration of my invention, incorporating the Fig. 1 controls and connections, as applied to a machine for loading tracer materials into bullets for small arms ammunition;

Fig. 3 represents the Fig. 2 device, except for

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the addition of a special support bracket for the flare detection head;

Fig. 4 is a diagrammatic view of the various elements, controls and wiring relationships of a modified form of my invention; and

Fig. 5 illustratively depicts an alternate form of my device incorporating the controls shown by Fig. 4.

The machine to which the present invention has illustratively been applied includes a frame-work 6 and a cross head 7 which supports a vertically acting ram 8 that drives a reciprocating punch 9. The machine further has a work table 11 that supports a conveyor mechanism 12 which carries, at regularly spaced distances, a supporting die 13. The machine is so adapted that each die is brought directly under the punch at the appropriate work station so that the punch and die are in correct axial alignment with each other. A portion of drive shaft 14 also is shown, this shaft being, through various linkages not represented in the drawings, connected to conveyor 12. Thus, for reasons which will later become clear, stoppage of shaft 14 will likewise result in a stoppage of the conveyor mechanism. Carried by shaft 14 is a brake drum 16. A gear reduction apparatus 17 is also associated with shaft 14, and leading from that apparatus is a flywheel 18 which is driven by a belt 19 connected to a rotor (not shown). A clutch 21 is provided for selective engagement of the flywheel in order to transmit motive power, supplied by the driving of belt 19, to shaft 14 whereby the machine's various mechanisms are motivated.

Clutch 21 is secured to one end of a lever 22 which pivots at its center 23 and has attached at its other end a cylinder 24 that forms part of an air motor to be described more fully below. The free end of cylinder 24 carries an appropriately lined brake band 26 which, when applied against brake drum 16, serves to halt rotation of shaft 14 and thus stop the machine's operation. By virtue of the pivotal construction of lever 22, cylinder 24 along with brake band 26 normally hover above the brake drum when clutch 21 engages flywheel 19, but when the brake band is applied against the brake drum, lever 22 is necessarily pivoted so that clutch 21 is withdrawn from engagement with the flywheel. This assures that the machine's motor-driven power will not be transmitted to shaft 14 when braking pressure is being applied thereagainst.

The air motor, of which the abovementioned cylinder 24 is a part, is of a conventional construction which also includes a diaphragm (not

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shown) secured within a housing 27 and an expansible spring (not shown) mounted within housing 28. Connected to this housing 27 is an air supply line 29 which is interrupted by an electrically operated air valve 31 and, adjacent to the air line's connection to housing 27, there is further provided an electrically operated air escape valve 32.

Mounted on the machine, by any conventional means is a flare detection head 33 that is aimed directly at a potential source of fire which is to be protected by the present invention. This detection head 33 may suitably take the form of a rectangular box (as shown), or any other suitable design provided with an opening therein through which may penetrate light rays. Housed within head 33 is a photo-voltaic cell 34 whose sensitivity is pre-selected so that it will be energized only when a certain minimum intensity of light falls thereon. Such pre-setting of the cell is necessary in order to assure that my novel apparatus is activated only by intense illumination such as that of a bright fire, thus safeguarding against activation by normal light sources. Optionally, there may be mounted in front of cell 34 a red or other suitable filter 36 which will serve to minimize the effect of stray light rays that may be reflected from the machine or objects in the surrounding locality and thereby accidentally activate the cell when no fire is present.

Two conventional "make-break" type mercury switches 37—38 are also mounted within head 33, each having important functions which will be described later. One form of these mercury switches is illustratively shown in Fig. 3 as consisting of an essentially spherical, sealed vial, into which extends two electrodes 59a—59b (in switch 37) and 59c—59d (in switch 38). The spherical vials each contain a pool of mercury 61 which, whenever the vial is properly positioned, serves to connect the electrodes and complete an electrical circuit. The electrodes may be in substantially parallel alignment and in a single plane, if preferred, or they may be in non-parallel or bi-planar relationship if desired, the only governing factor being that the electrodes should be so positioned, and the amount of mercury employed should be so regulated, that the electrodes will be electrically connected to each other when, and only when, the vial is in a desired critical position.

Mounting of the mercury switches 37—38 in flare detection head 33 may be done in any convenient manner, an example of which is illustrated in Fig. 3. The spherical vials which house the switches may, for example, be held by spring clips 65 which may be mounted on a bracket (not shown) or attached directly to the box housing of the flare detection head itself. The attachment of the clips may be made in a number of ways, but they always must be so positioned that when the flare head is aimed at a potential flare the mercury pool 61 will be in a position to complete the circuit (as in Fig. 3) by bridging the gap between electrodes 59a—59b and 59c—59d, respectively.

If my unique device is being employed under conditions where vibration is kept at a minimum, it will be sufficient to suspend the flare detection head by means of a semi-flexible cable 39, which conducts electricity to the parts carried by the head. For such purposes cable 39 may preferably be comprised of well-known "B-X" or other metal-armored, flexible material which has the

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property of staying in a relatively fixed position at all times except when an operator desires to move it to another position. Of course, if vibration is a factor to be considered so that a more positive support for the flare head is desired, a suitable bracket 67 (see Fig. 3) of non-flexible steel or other material may be employed. In the illustrative embodiment, bracket 67 consists of a substantially L-shaped bar, one end of which is attached by means of bolts 68 to flanges 69 that project from head 33. The other end of bar 67 is fastened to the machine's framework 6 by means of screws 71. By this simple method of attachment, head 33 may conveniently be swung out of position in order to make repairs, as aforesaid, simply by removing one of the screws 71 and pivoting the head away until the necessary clearance is obtained. The advantage of such a pivotable connection lies in the fact that it simplifies the job of properly relocating the detection head in the correct operating position with respect to the potential source of flares on the machine.

Also aimed at the machine's work station, where potential flares are expected, is a water line 41 terminating in a spray nozzle 42. Mounted in the water line just behind the spray nozzle is an electrically operated water valve 43. Between the valve 43 and the source of water supply is an electrically operated water pressure valve 44.

An electrical conduit 46 carries conducting wires from a remote control box 47 to air valves 31—32, flare head cable 39, water valve 43 and water pressure valve 44. Mounted within control box 47 is a sensitive micro-relay 48, a di-pole di-throw (D. P. D. T.) relay 49, two resistors 51 and a re-set button 52. Micro-relay 48 is a conventional device embodying a meter movement that utilizes its pointer as a relay contact which, as it approaches full scale deflection, is magnetically attracted to the other contact and firmly held in place. Re-set button 52, which is manually operated, serves to energize a coil (not shown) which electromagnetically repels the meter pointer from the full scale position, allowing it to fall toward the zero side of the scale, thereby breaking the relay circuit. Resistors 51 are for voltage dropping and current limiting purposes for the re-set coil and micro-relay contacts, respectively.

When the various above-described parts of my invention are in the condition illustratively represented by the drawings, the apparatus is in readiness to function at the instant a flare originates in the vicinity of die 13 or punch 9, as may frequently occur in the case of machines for loading sensitive tracer bullet compositions. In this condition, air valve 31 is open and air valve 32 is closed; clutch 21 is engaged with flywheel 18 and brake band 26 is supported free of brake drum 16; water valve 43 is closed; and water pressure valve 44 has its connection to the electrical system retained intact, so as not to interrupt the machine's operation, by virtue of the fact that the water pressure feeding through the valve equals or exceeds a pre-determined desired minimum.

In control box 47, micro-relay 48 is open, D. P. D. T. relay 49 is positioned so that electric current is able to pass by it through contacts 53 to energize air valves 31—32, but cannot get by the relay's open contacts 54 to energize water valve 43. In flare head 33, mercury switches 37 and 38 are, as explained previously, specially positioned (see Fig. 3) with reference to the

position assumed by the flare head when it is focused or aimed at a potential source of fire. Thus, when, and only when, the flare head is in this precise "aimed" position, mercury switches 37—38 are closed as in Fig. 3, the former completing the circuit between the photo-voltaic cell 34 and micro-relay 48, while the latter completes the circuit between the D. P. D. T. relay 49 and air valves 31—32, etc. If flare head 33 is moved from this pre-selected position, the contacts in switches 37—38 are broken because mercury 61 will thus be moved so as to break the connection between the electrodes, and the circuits which they normally help to complete are thereby disrupted. Such disruption not only renders my inventive apparatus inoperative, but by thus cutting off the current to valves 31—32, reverses the position of cylinder 24 to apply brake band 26 against brake drum 16 in a manner which will be explained below. At the same time, since the circuit involving the flare head and the relays has been broken, positive protection is given against the possibility of water issuing from line 41 and spray nozzle 42, even though light of considerable intensity strikes cell 34, as may readily occur when the cell is moved out of normal downward position.

Referring now to Figs. 4—5, there will be seen a modification of my invention which eliminates the use of the above-described mercury switches 37—38, and yet provides substantially the same sensitive control over the operation of my apparatus so that it becomes activated when, and only when, the flare head is pointed in a single, pre-determined direction. In this alternative construction, there is provided a conventional electrical micro-switch 72 which may be supported on the machine's framework 6 by means of a bracket 73 and screws 74. This switch has a resiliently mounted button 75 which, when it protrudes its maximum extent from switch 72, it is in the "break" position, but when the button is depressed it is in the "make" condition. To co-act with button 75 there is provided a projecting member 76 from the side of flare detection head 33A. This projection 76 serves to contact and depress button 75 when head 33A is in the operating position as shown in Fig. 5. As illustrated, button 75 and projection 76 may be given a substantially conical form so that they make what practically amounts to a single point contact, thereby increasing the sensitivity of their relationship as will later be explained.

For conveniently supporting the modified flare detection head 33A in the required position as shown in Fig. 5, there may suitably be provided a simple L-shaped flange or bracket 77, one end of which can be welded or brazed to the flare head, while the other is fastened to the machine by means of screws 78. When necessary to make repairs to the machine on which my device is employed, it is a simple task to remove screws 78 and lift head 33A out of the way; or, if desired, only one of the screws 78 need be removed, and the other sufficiently loosened so that the head can be pivoted away the necessary distance, thus making it easier to restore the head to the exact operating position later on. The advantage of having a substantially single point contact between projection 76 and micro-switch button 75 should now become evident: such contact of necessity insures that head 33A must be placed in the proper, pre-determined position before switch 72 is actuated, and furthermore, assures that the slightest deflection of head 33A (as would happen

if screws 78 were not sufficiently tightened or were removed) will likewise cause button 75 to revert to the "break" condition.

As will be seen from Fig. 4, except for the replacement of the mercury switches by micro-switch 72, the construction of the just described modification is essentially the same as the device schematically illustrated by Fig. 1. Micro-switch 72, as Fig. 4 shows, essentially consists of a dipole, di-throw, arrangement having a contact 79 which connects the electrical line leading from photo-voltage cell 34 to micro-relay 48, and a contact 80 which connects the electrical line leading from contact 53 of D. P. D. T. relay 49 and the electrical line that feeds air valve 31 and air escape valve 32.

Having thus described the various component parts of my invention, in preferred and suggested modified forms and with particular reference to the relative conditions of said parts when they are in a state of readiness awaiting activation caused by development of a sudden flare or fire, the respective actions of the various parts, as same take place when a fire occurs, may now be described. Assuming that a flare arises in the vicinity of punch 19 and die 13, the illumination therefrom is picked up by the photo-voltaic cell 34 and the electric impulse supplied thereby is transmitted to micro-relay 48. This impulse causes the meter movement of relay 48 to deflect up-scale, and its self-locking contacts energize the D. P. D. T. relay 49. This causes the contacts at 53 to open and the contacts at 54 to close. Opening of contacts 53 de-energizes air valves 31—32 so as to close the former and open the latter. This cuts off the air supply feeding through line 29 to air motor housing 27 and the air in that housing is permitted to escape through open valve 32. This relief of air pressure on the diaphragm (not shown) carried within housing 27 in turn releases the compressed spring (not shown), carried in housing 28, which then expands to force cylinder 24 and brake band 26 to move down into contact with brake drum 16. Simultaneously, as earlier explained, clutch 21 is disengaged from flywheel 18, both actions serving promptly to stop the operation of the entire machine.

Simultaneous with the de-energization of the air valves and the braking of the machine, the closing of contacts 54 furnishes electrical energy required to open valve 43 and water is thereby caused to pour from line 41 and spray nozzle 42 on the area of the fire. This water flow will continue until valve 43 is closed by re-opening contacts 54, which may be done by an operator pressing re-set button 52 in the remote control box. Pressure on button 52 not only closes off the water supply but closes contacts 53 so as to restore the air valves to their normal operative positions, and likewise re-open the micro-relay switch 48, thus placing the apparatus once again in condition for instantaneous operation in the event of a future fire.

Now that the operation of my unique apparatus has been fully explained, it will be well to emphasize the noteworthy manifold safety features thereof, even though some of them will have been obvious from the foregoing description. Of outstanding importance is the fact that the machine to which my invention is applied absolutely cannot be operated unless the flare detection and flare extinguishing elements of my apparatus are in proper condition for functioning in case a fire should develop. If the flare detection head 33 (or modified form 33A) is not properly aimed at the

expected fire locale, the appropriate electrical circuit is broken, as explained above, and the brake system is activated to prevent the machine's operation. Similarly, if there should be a failure of the electrical system or of the air pressure, the machine will not be operable as the clutch will be disengaged and the braking mechanism will be applied to prevent movement of shaft 14, conveyor 12, etc., until the trouble is rectified. As a further precaution, to assure that a ready supply of water (or other fire extinguishing fluid) is available at all times when the machine is operating, the electrically operated water pressure valve 44 serves to stop the machine in case that pressure drops below a pre-determined requisite minimum. Valve 44 is electrically connected to the machine's current source so that a drop of water pressure below the pre-set minimum causes an interruption in the electric current which passes through the valve's connection to the electric line, and the entire machine is thus rendered inoperative until the condition is rectified.

From the foregoing it will be seen that my invention will detect fires in machinery and almost simultaneously stop the machine's operation while deluging the area with a fire extinguishing medium, and also will prevent operation of the machine until all the elements necessary to such protective action are in condition properly to function; that I have provided a device which will detect fires by photo-sensitive means and which through various linkages stops the machine's operation and floods the fire with water or other extinguishing fluid; that I have provided such a device which will permit the photo-sensitive means to be moved so that workmen would have free access to the machine for purpose of repairing, etc., but yet prevent operation of the machine until the photo-sensitive means is in readiness, and the water supply is adequate; that I have assured that when the photo-sensitive means is moved the fire detection and extinguishing apparatus will not be activated by virtue of light from a source other than the potential fire hazard striking the photo-sensitive detector; and that I have provided such apparatus which is relatively inexpensive and which may readily be adapted for use in most machines wherein flares are likely to occur.

Of course, even though only one specific embodiment of my invention has been illustrated and described, it will be obvious to those skilled in the art that many modifications are possible without departing from the spirit and scope of the invention. That is to say, my invention is extensive in its adaption and is not to be limited unnecessarily to the specific forms here shown by way of illustration.

I claim:

1. In combination with a machine which bears a potential fire hazard, a source of electric current and means for supplying it to said machine, a flare detection head, means for movably mounting said detection head with respect to said machine, a normally open electric circuit carried by said detection head and connected to said current source, electrically responsive means for closing said circuit, photo-sensitive means carried by said detection head for developing sufficient electrical energy to actuate said electrically responsive means and close said circuit, and adapted to be activated upon detection of a pre-determined minimum illumination, air-operated mechanism for braking the machine, electrically

responsive air valve means effective so long as energized by the electrical energy supplied from said current source for maintaining said air-operated braking mechanism in released condition and for applying said braking mechanism when the electric energization thereof is discontinued, and a "make-break" type electrical switch actuated by movement of said detection head away from a predetermined position and connected in the line between said current source and said valve means so that when and only when the head is focused in a single predetermined direction the switch is in the "make" condition whereby electrical energy from said current source energizes said air valve means which is thus kept open and the braking mechanism released, but when the head is moved in any other direction the switch is in the "break" condition causing an interruption in the flow of electrical energy to said air valve means and thus operate the braking mechanism to make the machine inoperative.

2. For use with a machine which bears a potential fire hazard, a source of electric current and means for supplying it to said machine, a flare detection head having photo-sensitive means for developing electrical energy and adapted to be activated upon detection of a pre-determined minimum illumination, means for movably mounting said detection head with respect to said machine, means for projecting a fire extinguishing fluid upon said machine, electrically operated valve means open so long as energized by the electrical energy supplied from said current source to enable the fire extinguishing fluid to deluge the machine but normally remaining closed to stop the fluid's flow when the electric energization is discontinued, an electrical relay connected in the line between said current source and said valve means and normally open to interrupt the circuit but which closes when said detection head's photo-sensitive means is activated so as to allow electricity from said current source to energize said valve means, and a "make-break" type electrical switch actuated by movement of said detection head away from a predetermined position and connected to said photo-sensitive means so that when and only when the head is focused in a single predetermined direction the switch is in the "make" position whereby electrical energy from the photo-sensitive means closes said relay to complete the circuit and in turn opens said valve means to start the flow of the fire extinguishing fluid, but when the head is focused in any other direction the switch is in the "break" position whereby no electrical energy is supplied to close said relay and thus the valve means remains closed and the flow of fire extinguishing fluid is prevented.

3. In combination with a machine which bears a potential fire hazard, a source of electric current and means for supplying it to said machine, a flare detection head, means for movably mounting said detection head with respect to said machine, photo-sensitive means carried by said detection head for developing electrical energy and adapted to be activated upon detection of a pre-determined minimum illumination, means for projecting a fire extinguishing fluid upon said article, electrically operated valve means which remains open so long as energized by the electrical energy supplied from said current source to enable the fire extinguishing fluid to deluge the machine but normally remaining closed to

stop the fluid's flow when the electric energization is discontinued, a normally open electric circuit carried by said detection head, an electrical relay connected in said circuit between said current source and said valve means for closing said circuit when said detection head's photo-sensitive means is activated so as to energize said valve means, and an electrically energized fluid pressure valve fitted into the line supplying the fire extinguishing fluid and electrically connected to said current source, the fluid pressure valve serving to interrupt the supply of electric current necessary to operate the machine whenever the pressure of fire extinguishing fluid passing through that valve drops below a predetermined minimum necessary for effective use in extinguishing fires that may develop in said machine.

4. In combination with a machine which bears a potential fire hazard, an electrical circuit including a source of electrical current and means for supplying it to said machine, a flare detection head, means for movably mounting said detecting head with respect to said machine, a normally open electric circuit carried by said detection head and connected to said current source, electrically responsive means for closing said circuit, photo-sensitive means carried by said detection head for developing sufficient electrical energy to actuate said electrically responsive means and close said circuit, and adapted to be activated upon excitation by a predetermined minimum illumination, means for mechanically stopping operation of the machine, means for projecting a fire extinguishing fluid upon said machine, electrically responsive controls for operating said machine stopping means and said fluid projecting means, and electrical switch means carried by said detection head and connected in the electrical circuit for selectively opening the circuit to prevent operation of the machine and said fluid projecting means, and closing the entire circuit save for the portion controlled by said photo-sensitive means.

5. In combination with a machine which bears a potential fire hazard, a source of electric current and means for supplying it to said machine, a flare detection head, means for movably mounting said detection head with respect to said machine, a normally open electric circuit carried by said detection head and connected to said current source, electrically responsive

means for closing said circuit, photo-sensitive means carried by said detection head for developing sufficient electrical energy to actuate said electrically responsive means to close said circuit, and adapted to be activated upon detection of a predetermined minimum illumination, air-operated mechanism for braking the machine, electrically responsive air valve means effective so long as energized by the electrical energy supplied from said current source for maintaining said air-operated braking mechanism in released condition and for applying said braking mechanism when the electric energization thereof is discontinued, means for projecting a fire extinguishing fluid upon said machine, electrically operated valve means open so long as energized by the electrical energy supplied from said current source to enable the fire extinguishing fluid to deluge the machine but normally remaining closed to stop the fluid's flow when the electric energization is discontinued, an electrical relay connected in the line between said current source and said electric valve means and normally open to interrupt the circuit but which closes when said detection head's photo-sensitive means is activated so as to allow electricity from said current means to energize said valve means, a first "make-break" type electrical switch carried by said detection head and connected in the line between said photo-sensitive means and said relay, a second "make-break" type electrical switch also carried by said detection head and connected in the line between said current source and both said air valve means for controlling the brake and said electric valve means for controlling the fluid projecting means, and a "di-polar, di-throw" type electrical switch connected so as to be operated upon activation of said relay and operable selectively to close the circuit which operates said braking mechanism and alternatively to close the circuit which causes projection of the fire extinguishing fluid on the machine.

EUGENE ROFFMAN.

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The following references are of record in the file of this patent:

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