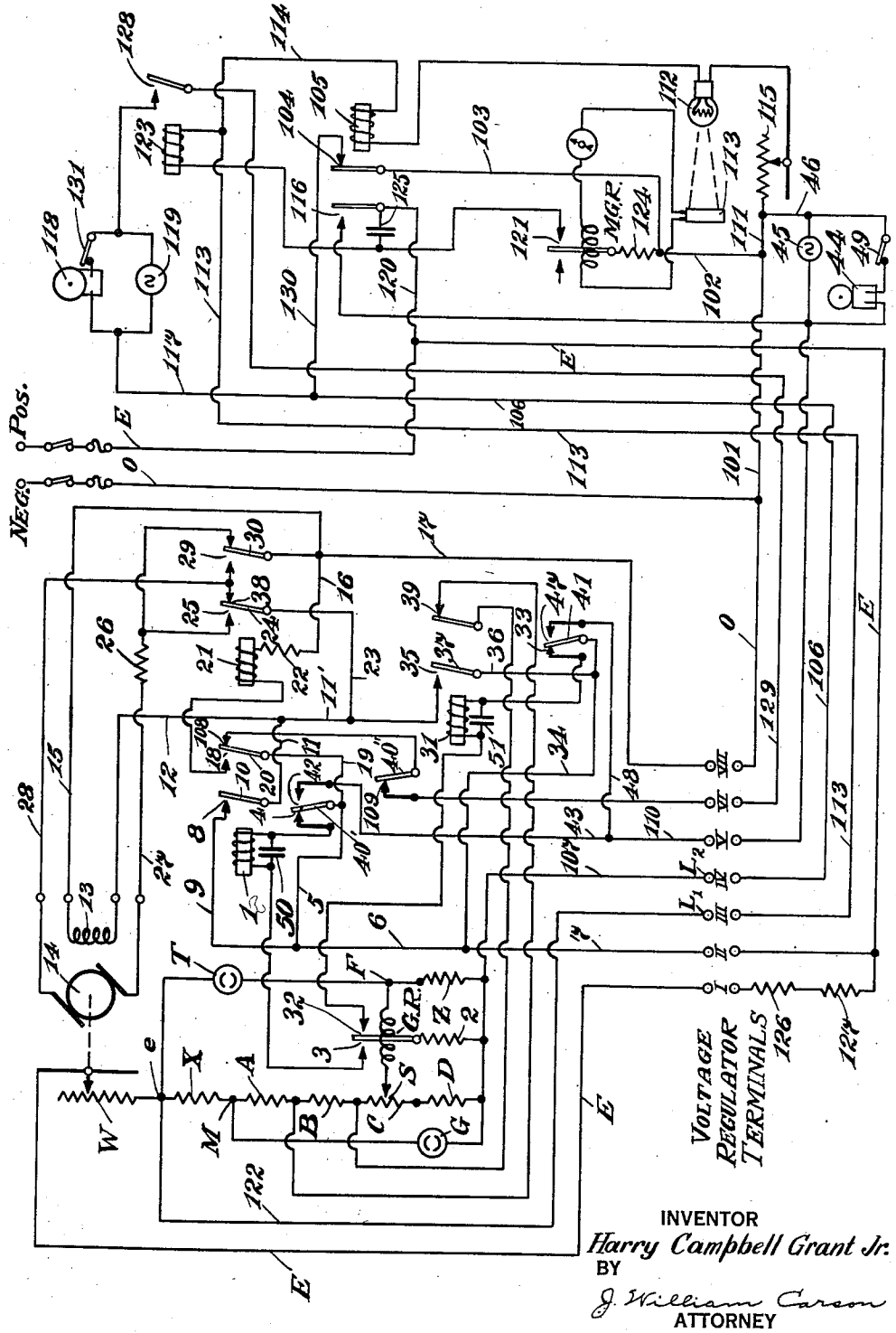
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REGULATED VOLTAGE SYSTEM FOR DETECTING SUSPENDED MATTER IN FLUIDS

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2 Claims. (Cl. 177—311)

The present invention relates broadly to smoke or other suspended matter detecting apparatus of the type employing a source of light directed upon a light-sensitive element with a fluid current flowing along the path of the beam of light directed from the source of light upon the light-sensitive element and in which the presence of smoke or other suspended matter in the fluid current acts to decrease the intensity of the light falling upon the light-sensitive element and to thereby cause an alarm signal to be rendered.

In such apparatus as previously employed, it has been found that if the light-sensitive element circuit is adjusted to give detection for a reasonably light smoke density, it will also give false smoke alarms for a drop in the line voltage as little as four volts, it being understood, of course, that a drop in the line voltage will cause a decrease in the intensity of the light emitted by the source of light, being the same condition as is produced by the presence of smoke in the fluid current flowing along the path of the beam of light directed from the source of light upon the light-sensitive element.

The desirability of having a regulated voltage for detecting apparatus of the type referred to will therefore be apparent.

It is accordingly an object of the present invention to provide a regulated voltage system for detecting the presence of suspended matter in fluids.

It is a further object of the present invention to provide a system of the type referred to in which a drop in the voltage applied to the system, requiring an adjustment of the voltage, causes the smoke alarm signals to be rendered inoperative during the time that the voltage is being adjusted to its proper value.

It is another object of the invention to provide a system of the type referred to in which a drop in the voltage applied to the system of a magnitude beyond the adjusting range of the voltage regulating arrangement will cause the smoke alarm signals to be rendered inoperative and a trouble signal to be instituted.

It is still another object of the invention to provide a system of the type referred to in which the voltage regulating arrangement is deenergized upon failure of the main light source of the smoke detecting arrangement, so as to protect the galvanometer of the voltage regulating arrangement against the heavy overload which would result upon the removal of the current passed through the main light source.

It is a still further object of the invention to provide a suspended matter detecting apparatus of the type broadly referred to, in which no suspended matter alarm is given upon a decrease in the intensity of the main light source due to other causes than the presence of suspended matter in the fluid current.

These, and other objects of the invention, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the single figure of the accompanying drawing, which is a conventional view showing the electrical circuits and connections of a regulated voltage system for detecting suspended matter in fluids in accordance with the present invention.

For convenience in describing the subject-matter of the present invention, the description will first be directed to the voltage regulating arrangement, which may be of any suitable type, but which in the present instance is substantially in accordance with Figure 1 of my co-pending application for Letters Patent of the United States entitled Voltage regulation, Serial No. 687,835 and filed on even date herewith, the same reference characters having been employed in both applications, wherever possible, for all elements which are the same, different reference characters being employed for those additional elements required for bringing the voltage regulating arrangement into cooperation with the smoke detecting arrangement of the present invention.

Referring now to the drawing, the unregulated voltage is applied from the positive POS. of the source of electric potential to the terminal line E and from the negative NEG. to the terminal line O. The regulated positive voltage is obtained from terminal L_1 (III) of the voltage regulator terminals, the negative terminal being shown at L_2 (IV). As explained in my herein above referred to co-pending application, when the voltage across terminals E and O drops, galvanometer relay G. R. deflects to the left, causing the relay 1 to operate through a circuit from negative terminal line O, through wires 101, 102, 103, through contact 104 of relay 105, through wire 106, through terminal IV of the voltage regulator terminals, through wire 107, through resistance 2, through the now closed contact 3, through the relay 1, through the normally closed contact 4, and through wires 5, 6 and 7 to the positive terminal line E, causing the relay 1 to operate. The operation of the relay 1 first of all closes the contact 8, permitting a current to flow from the positive terminal line E, through wires 7, 6 and 9, through contact 8, through armature 10, through

wires 11 and 12, through the field 13 of the voltage regulator motor 14, through wires 15 and 17, to the negative terminal line O. Then, closing of the contact 18 of the relay 1 permits current to flow from the positive terminal line E, through wires 7, 6, 5 and 19, through armature 20, through contact 18, through the relay 21, through the resistance 22, and through wires 16 and 17 to the negative terminal line O, causing the relay 21 to operate. Current then flows from the positive terminal line E, through wires 7, 6 and 9, through contact 8 of the relay 1, through wires 11' and 23, through armature 24 of the relay 21, through the now closed contact 25, though resistance 26, through wire 27, through the armature of the voltage regulator motor 14, through the wire 28, through the now closed contact 29 of the relay 21, through the armature 30, and through wire 17 to the negative terminal line O. Since both the armature and the field 13 of the voltage regulator motor 14 are now connected to positive and negative, this motor causes the motor driven rheostat W to turn so as to reduce its resistance and bring the regulated voltage at terminal L_1 (e) to its proper value. When the voltage at terminal L_1 (e) is correct, the contacts of the galvanometer relay G. R. clear, releasing the relay 1 and the relay 21, permitting the voltage regulator motor to stop.

It will also be noted that the relay 1 controls a normally closed contact 108 which, as will be described hereinafter, controls the energization of the smoke signals of the smoke detecting arrangement. Since, as pointed out at the beginning of this specification, a decrease in the line voltage as little as four volts will cause a false smoke alarm to be given, and since the relay 1 is operated upon a drop in the voltage across terminals E and O, contact 108 will be opened upon operation of the relay 1 and will remain open all during the time that the voltage is being adjusted to its proper value. Consequently, no false smoke alarm will be given, as the smoke signals cannot be rendered while contact 108 is open.

When the voltage across terminals E and O increases, the galvanometer relay G. R. deflects to the right, causing the relay 31 to operate through a circuit from the negative terminal line O, through wires 101, 102 and 103, through contact 104 of relay 105, through wire 106, through terminal IV, through wire 107, through resistance 2, through the now closed contact 32, through the relay 31, through the normally closed contact 33, through wires 34 and 7 to the positive terminal line E. The operation of the relay 31 closes the contact 35, permitting a current to flow from positive terminal line E, through wires 7, 34 and 36, through armature 37 of the relay 31, through contact 35, through wires 11' and 12, through field 13 of the voltage regulator motor 14, and through wires 15 and 17 to negative terminal line O, thus energizing the field 13 in exactly the same sense as it is energized by operation of the relay 1. However, the relay 21 is not energized upon operation of the relay 31 (as it is upon operation of the relay 1), so that the direction of the current through the armature of the voltage regulator motor 14 is reversed, causing the motor to turn in the opposite direction and to bring the regulated voltage at terminal L_1 (e) to its proper value. In accomplishing this, the connection from the positive terminal line E is through the contact 38 of the relay 21 to the wire 28 connecting to one side of the armature of the motor 14, instead of through contact 25 of the relay 21 to the wire 27 connecting to the other side of the armature of the motor 14.

It will be noted that if the voltage changes sufficiently, the motor driven rheostat W will reach its limit in one direction or another. While the regulator as described is operable to produce a constant regulated voltage from a source of electric potential varying over a wide range, it will not regulate over the entire range, and it is accordingly necessary to provide means for preventing mechanical injury to the rheostat and its driving mechanism. Limit switches are accordingly provided on the rheostat and arranged in such a manner that their circuits are opened before the mechanical limit of the rheostat is reached. These limit switches are shown at 40'—40'' and 41 for the relays 1 and 31 respectively. Operation of the element 40' of the limit switch 40'—40'' when the rheostat W has reached one limit of its motion disconnects the relay 1 by breaking its energizing circuit at the contact 4 of the limit switch, causing the voltage regulator motor 14 to stop. Since, however, deenergization of the relay 1 causes closing of contact 108, which as already explained controls the energization of the smoke alarm signals, element 40'' of the limit switch 40'—40'' is operated simultaneously with the operation of the element 40' of the limit switch, resulting in the opening of contact 109, which acts similarly to contact 108 to control the energization (and deenergization) of the smoke alarm signals.

On the other hand, opening of the limit switch 41 when the rheostat W has reached the other limit of its motion disconnects the relay 31 by breaking its energizing circuit at the contact 33 of the limit switch, likewise causing the voltage regulator motor 14 to stop.

At the same time that the contact 4 of the limit switch 40'—40'' is opened, the contact 42 of the limit switch is closed, thus completing a circuit from the positive terminal line E, through wires 7, 6 and 5, through contact 42, through wire 43, through wire 110, through a trouble bell 44 and a trouble lamp 45 in parallel, and through wires 46, 111 and 101 to negative terminal line O. Similarly, at the same time that the contact 33 of the limit switch 41 is opened, the contact 47 of the limit switch is closed, thus completing a circuit from positive terminal line E, through wires 7 and 34, through contact 47, through wires 48 and 110, through the trouble bell 44 and trouble lamp 45 in parallel, and through the wires 46, 111 and 101 to negative terminal line O. It will therefore be seen that trouble signals are given when the unregulated line voltage is too high or too low, i. e., beyond the adjusting range of the regulator, so that proper steps may be taken at once to correct the voltage directly at the source. A switch 49 is provided in the circuit of the trouble bell 44 so that the trouble bell may be stopped, but the trouble lamp 45 remains lighted until the trouble has been corrected.

Certain other features of construction of the voltage regulating arrangement having no direct bearing on the present invention have not been described herein, as the manner of operation of the same can be ascertained from my herein above referred to co-pending application.

The smoke detecting arrangement of the present invention will now be described with reference to the drawing, in which 112 is the main light source from which light is directed upon the light-sensitive element 113, the latter of which is of the photo-voltaic type requiring no

source of electric potential for operation thereof.

As it is one of the objects of the present invention to provide a regulated voltage system for detecting suspended matter in fluids, the energizing voltage for the main light source 112 is obtained from the regulated voltage terminals L_1 (III) and L_2 (IV) of the voltage regulator terminals, connection being from the positive terminal L_1 through wires 113 and 114, through the relay 105, through the main light source 112, through the meter control resistance 115, and wires 111 and 101 to the negative terminal line O, causing the operation of the relay 105 and the main light source 112. The voltage is therefore maintained constant across the series circuit comprising the relay 105, the main light source 112 and the meter control resistance 115. The meter control resistance 115 is provided to permit the manual adjustment of the voltage across the main light source 112 to increase the light output thereof as the optical system becomes dirtier with increasing time and as the light output decreases due to the aging of the lamp; this manual control requiring infrequent adjustment. Failure of the main light source 112 permits the release of the relay 105, opening the contact 104, and closing the contact 116.

Opening of contact 104 of the relay 105 serves a double purpose, first of all breaking the connection from the negative terminal line O, through wires 101, 102 and 103, through contact 104 and through wire 117 to one side of the smoke alarm signal gong 118 and the smoke alarm signal lamp 119, preventing operation of the smoke alarm signals, which would give a false alarm upon the extinguishing of the main light source 112. Opening of the contact 104 also results in breaking the connection from the negative terminal line O, through wires 101, 102 and 103, through contact 104, and through wire 106 to the negative terminal L_2 of the voltage regulating arrangement, thus causing deenergization of the voltage regulating arrangement upon failure of the main light source 112, so as to protect the galvanometer G. R. of the voltage regulating arrangement against the heavy overload which would result upon the removal of the current passed through the main light source.

Of course, closing of contact 116 of the relay 105 gives a trouble signal to indicate that the main light source 112 has failed, the trouble signal connections being from the positive terminal line E through wire 120, through contact 116, through the trouble bell 44 and the trouble lamp 45 in parallel, and through wires 46, 111 and 101 to the negative terminal line O.

When the proper light intensity is directed from the main light source 112 upon the light-sensitive element 113, the contact 121 of the main galvanometer relay M. G. R. is held open. Introduction of smoke, reducing the light intensity on the light-sensitive element, permits the contact 121 to close, causing a current to flow from the positive terminal line E to the terminal I of the voltage regulator terminals, through the motor driven rheostat W, through the wire 122, through the terminal L_1 (III), through wire 113, through the main smoke relay 123, through contact 121 of the main galvanometer relay M. G. R., through resistance 124, and through wires 102 and 101 to the negative terminal line O, causing operation of the main smoke relay 123. Resistance 124 is used to reduce the current to the proper operating value of the relay 123. The condenser 125 shown to the left of the relay 105 is connected across the relay 123 to eliminate arcing of the contacts of the main galvanometer relay M. G. R. The one side of the condenser 125 connects directly with the main smoke relay 123. The other side connects directly with the positive terminal line E. As the other side of the main smoke relay 123 connects to the positive terminal line E through the motor driven rheostat W and the resistances 126 and 127, the condenser 125 is actually connected across relay 123 in series with these resistances.

Operation of relay 123 closes contact 128, causing current to flow from the positive terminal line E, through terminal II of the voltage regulator terminals, through wires 7, 6, 5 and 19, through armature 20 of the relay 1, through contact 108, through element 40'' of the limit switch 40'—40'', through contact 109, through terminal VI, through wire 129, through contact 128 of the main smoke relay 123, through the smoke alarm signal gong 118 and the smoke alarm signal lamp 119 in parallel, through wires 117 and 130, through contact 104 of relay 105, and through wires 103, 102 and 101 to the negative terminal line O, thus causing operation of the gong 118 and the lamp 119. Operation of the gong switch 131 cuts the operating circuit of the smoke alarm signal gong 118, but leaves the circuit through the smoke alarm signal lamp intact. As previously pointed out, contact 104 is controlled by relay 105, which is the supervising relay for the main light source 112; so that failure of the main light source 112, with consequent deenergization of the relay 105, cuts the energizing circuit of the main smoke alarm signals 118 and 119. At the same time contact 104 cuts the energizing circuit of the voltage regulating arrangement, as already previously described.

From the foregoing description it will be seen that I have first of all produced a practicable regulated voltage system for detecting suspended matter in fluids, and that I have accomplished all of the various objects set out at the beginning of this specification. It will of course be understood that any suitable voltage regulating arrangement may be employed in combination with my suspended matter detecting arrangement, and that I have simply employed the voltage regulating arrangement described in my hereinbefore referred to co-pending application as a matter of convenience and by way of example. In fact, my invention is capable of being carried out in various styles of execution, and I accordingly do not wish to be limited, save as defined in the appended claims.

I claim:

1. In combination an apparatus of the type employing a source of light directed upon a light-sensitive element and an alarm controlled by a decrease of the intensity of light falling upon the light-sensitive element, voltage regulating means for maintaining substantially a constant regulated voltage on the source of light, said voltage regulating means being energized from a source of electric potential subject to fluctuation in voltage, and means to protect the voltage regulating means against the overload which would result upon failure of the source of light due to the removal of the current demand of the source of light comprising a normally energized relay in the energizing circuit of the source of light, and a normally closed contact in the energizing circuit of the voltage regulating means, said contact being controlled by said relay and being

broken upon deenergization of the relay due to failure of the source of light.

2. In combination an apparatus of the type employing a source of light directed upon a light-sensitive element and an alarm controlled by a decrease of the intensity of light falling upon the light-sensitive element, means for maintaining substantially a constant regulated voltage on the source of light comprising regulatable voltage changing means, voltage increasing means operable upon a decrease in voltage below the desired constant voltage to effect operation of the voltage changing means to effect an increase in voltage, voltage decreasing means operable upon an increase in voltage above the desired constant voltage to effect operation of the voltage changing means to effect a decrease in voltage, means to prevent a false alarm signal upon a decrease in voltage below the desired constant voltage comprising a normally closed contact in the energizing circuit of the alarm which is opened upon operation of the voltage increasing means and closed again upon cessation of operation of the voltage increasing means, and means to prevent a false alarm signal whenever the voltage changing means reaches the limit of its voltage increasing effect at a time when the regulated voltage is still below the desired constant voltage comprising a second normally closed contact in the energizing circuit of the alarm which is opened whenever the voltage changing means reaches the limit of its voltage increasing effect.

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