United States Patent [19]

Bart

[11] **3,739,267**

[45] **June 12, 1973**

[54] **APPARATUS FOR DETECTING CONDUCTIVE MATERIAL UTILIZING A VAPOR LAMP**

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[73] Assignee: **United States Steel Corporation**

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[21] Appl. No.: **249,593**

[52] **U.S. Cl.** ..... **324/71 R,** 313/201, 324/61 R, 340/246

[51] **Int. Cl.** **G01n 27/00**

[58] **Field of Search** 324/61, 71; 340/246; 313/201

[56] **References Cited**

UNITED STATES PATENTS

3,626,288 12/1971 Bart ..... 324/71 R

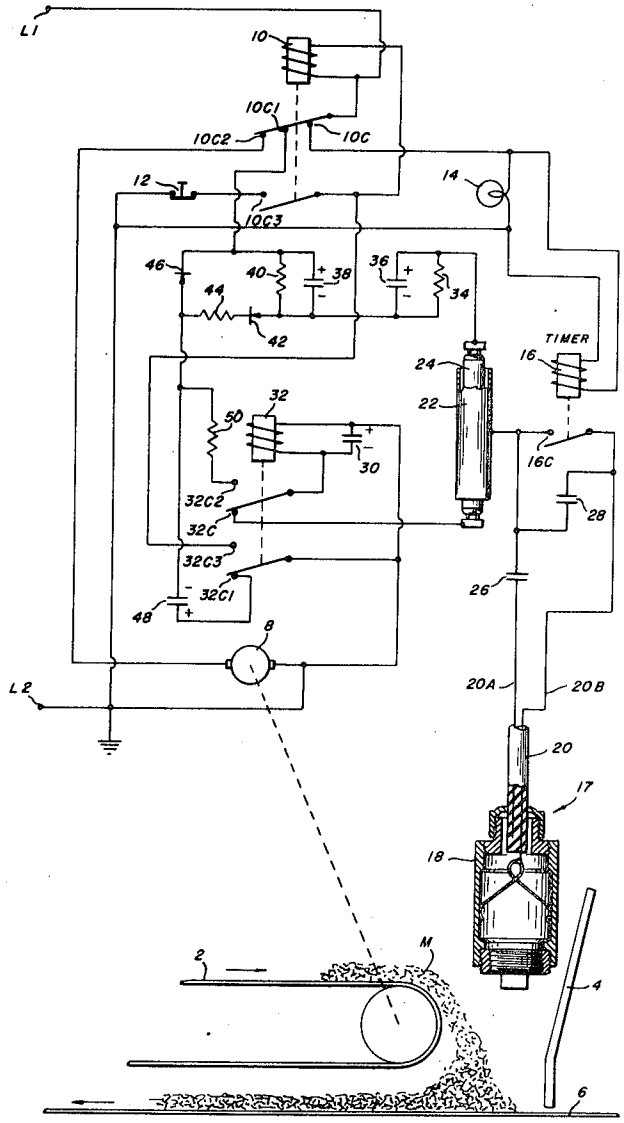
Primary Examiner—Robert J. Corcoran

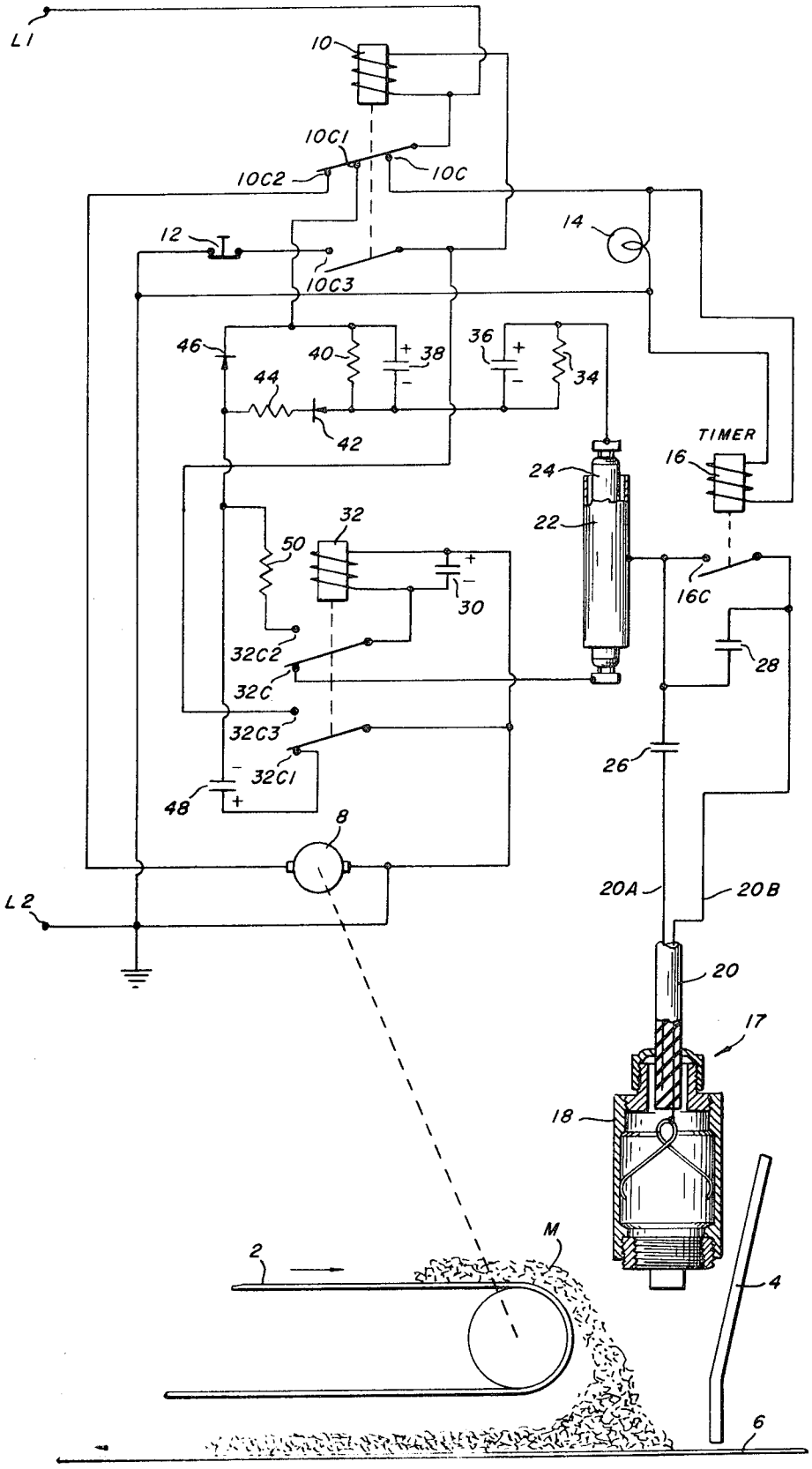
Attorney—Martin J. Carroll

[57] **ABSTRACT**

Apparatus for detecting conductive material, particularly a build-up at the end of a conveyor, includes a vapor lamp, an electrically conductive means around at least a portion of the lamp periphery, an AC power source, a biasing circuit for supplying a high potential DC charge to said lamp, and a probe. The probe includes a conductor adapted to contact the material and two insulated conductor leads connected to the electrically conductive means. One end of the first lead is connected to the detector conductor and the adjacent end of the second lead is insulated from the detector conductor and the first lead. A capacitor is connected in each lead. A timer relay contact is connected in parallel with the capacitor in the first lead. When conductive material is detected, the vapor lamp conducts and a circuit stops movement of the conveyor.

6 Claims, 1 Drawing Figure




L1
10
10C1
10C2
10C
12
14
10C3
46
40
38
36
34
44
42
TIMER
16
24
22
32
50
30
16C
32C2
28
32C
32C3
26
32C1
48
8
L2
20A
20B
20
17
18
M
2
4
6

APPARATUS FOR DETECTING CONDUCTIVE MATERIAL UTILIZING A VAPOR LAMP

This invention relates to a probe device and more particularly to a probe for detecting conductive material such as the build-up of moist iron ore at the end chute or enclosure of a conveyor. Such material, being moist and of a fine texture, tends to pack and build up in the discharge end chute of the conveyor. To prevent electrical overloading and stopping of the conveyor motor, spillage and wasted time, it is necessary to include in the conveyor system means to monitor transfer of material at the discharge end of the conveyor. Apparatus suitable for this purpose is shown in my prior U.S. Pat. No. 3,626,288 dated Dec. 7, 1971. However, the apparatus shown therein, especially the probe thereof, operates in such a manner that the vapor lamp used may be rendered ineffective. I have found that this results from too rapid repeated resettings and tube ignitions. It is normally necessary to locate the tube a considerable distance from the material to be detected. To protect the leads it is desirable to place the cable in a grounded metal conduit, but this cannot be done with my patented device without danger of the tube firing inadvertently. Such inadvertent firing may also result when the surface of the conductor insulation is in contact with any other conductive and ground connected surface. The patented apparatus is reset by manually moving its armature which is time consuming and somewhat dangerous.

It is therefore an object of my invention to provide apparatus for detecting the presence of conductive material which protects the vapor lamp used from damage due to rapid resettings and tube ignitions.

Another object is to provide such apparatus which includes a probe which will not ignite the tube inadvertently by contact of its insulated leads with conductive and ground connected surfaces.

A further object is to provide such apparatus which may be safely and easily reset.

These and other objects will be more apparent after referring to the following specification and attached drawing, in which:

The single FIGURE is a schematic view showing the detector and control of my invention connected to control a conveyor.

Referring more particularly to the drawing, a first conveyor 2 transports electrical conductive material M to its discharge end where the material is guided and shifted by means of chute 4 to a second conveyor 6 which moves the material in the direction of the arrow. The first conveyor 2 is driven by an electric motor 8. A 115 volt alternating current source provides power to terminals or lines L1 and L2. The source at terminal L2 is connected to earth potential or grounded. A relay coil 10 having normally closed contacts 10C, 10C1, and 10C2 and normally open contacts 10C3 is connected across lines L1, L2 in series with contact 10C3 and switch 12. Power is provided to motor 8 from lines L1, L2 through contact 10C2. A signal light 14 and timer relay coil 16 are connected in parallel to lines L1, L2 through contact 10C. Relay coil 16 has a normally open contact 16C which is set to close a set time — preferably 50 seconds after coil 16 is energized. An electrically conductive sensing probe 17 includes an electrical conductor 18 positioned adjacent the discharge end of conveyor 2 and two insulated leads 20A and 20B of a two conductor No. 18 Packing House

cable 20 which are connected to aluminum shield 22 of vapor tube 24 which is preferably a fluorescent tube as in my above mentioned patent. One end of lead 20B is connected to conductor 18 while the adjacent end of lead 20A is insulated from lead 20B and conductor 18. Mica capacitors 26 and 28 are connected in leads 20A and 20B, respectively. Contact 16C is connected in parallel with capacitor 28. Capacitor 26 is preferably a Type E2 Cornell Dubilier having a capacity of 105 microfarads and capacitor 28 a Type O Mica Mold having a capacity of 200 microfarads. I have found that up to 12 ft., but preferably no more than 9 ft., of cable 20 can be enclosed in a grounded metal conduit without causing inadvertent ignition of tube 24.

One side of tube 24 is connected to line L2 through capacitor 30 and relay coil 32 connected in parallel and through normally closed contacts 32C. Relay coil 32 also has normally closed contacts 32C1 and normally open contacts 32C2 and 32C3. Capacitor 30 is preferably a 30 mfd. 450 V. D. C. electrolytic capacitor. The other side of tube 24 is connected to line L1 through resistor 34 and capacitor 36 connected in parallel, capacitor 38 and resistor 40 connected in parallel with each other and in parallel with silicon rectifier 42, resistor 44 and silicon rectifier 46 connected in series, and then through contact 10C1. Both capacitors 36 and 38 are preferably 450 V. D. C. electrolytic capacitors with capacitor 36 having a capacity of 40 mfd. and capacitor 38 a capacity of 100 mfd. Resistor 34 preferably has a value of 43,000 ohm and 1 watt, resistor 40 a value of 45,000 ohms and 1 watt, and resistor 44 is preferably a 2 unit Ohmite Brown Devin No. 1752 having a total resistance of 15,000 ohms. The rectifiers 42 and 46 are preferably Syntron Type 1 N 3293 R No. 660303. Line L2 is connected to the junction between resistor 44 and rectifier 46 through a circuit including capacitor 48 and contact 32C1 and a parallel circuit of resistor 50, contact 32C2 and parallel connected capacitor 30 and coil 32. Capacitor 48 is preferably an electrolytic capacitor having a capacity of 40 mfd. and 600 V. D. C. Resistor 50 is preferably an Ohmite 270-205 P 46, 300 ohms ±5.

It will be seen that the parts 1, 3, 5, 6 and 18 constitute a direct-current-biasing circuit like that shown by the reference number 8 of my above identified patent and that parts 2 and 20 constitute the current limiting circuit 14 of that patent.

In operation, with the parts in the position shown, during one half of the cycle current flows from L1 through contact 10C1, rectifier 46, capacitor 48 and relay contacts 32C1 to L2; thus charging capacitor 48 to approximately peak line voltage. During the other half cycle, current flows from L2 through relay contacts 32C1, capacitor 48, resistor 44, rectifier 42, capacitor 38 and resistor 40 connected in parallel, and relay contacts 10C1 to L1; thus charging capacitor 38 to approximately twice peak line voltage.

In another circuit, current flows between L1 and L2 through relay contacts 10C and the parallel connected indicating light 14 and timer relay coil 16. Thus, timer relay contacts 16C will be closed 50 seconds after coil 16 is energized. This time lapse was selected because it was deemed sufficient to prevent the electronic tube from being rendered ineffective even though it should be ignited repeatedly every 50 seconds.

When voltage develops across tube 24 as capacitor 38 acquires a potential build-up, it is believed that a

condition exists whereby the combined capacitance of the conductor **18** and the conductors **20A** and **20B** of cable **20** are in series with capacitors **26** and **28** and the tube shield **22.** In this conditioning an ion stability is established within tube **24** which is still maintained after timer contacts **16C** close so that tube **22** will not ignite inadvertently. However, when material M builds up and contacts conductor **18** tube **24** will ignite. This causes current to flow from L1 through relay contacts **10C1,** charged capacitor **38,** capacitor **36,** tube **24,** relay contacts **32C,** and relay coil **32** and capacitor **30** connected in parallel to L2. This charges capacitor **36** which acts as a safety device which prevents capacitor **38** from charging backwards and also prevents damaging tube **24** through excessive current. Capacitor **30** acquires a charge and discharges through coil **32** to energize coil **32** during the transition time between the opening of contacts **32C** and **32C1** and the closing of contacts **32C2** and **32C3.** When contacts **32C2** close, half cycle current flows from L1 through contacts **10C1,** rectifier **46,** voltage limiting resistor **50,** contacts **32C2** and parallel connected capacitor **30** and relay coil **32** to L2. When contacts **32C3** close relay coil **10** is energized to open contacts **10C, 10C1** and **10C2** and close contact **10C3.** Opening of contacts **10C** deenergizes light **14** and relay coil **16,** thus indicating that material has been detected. Opening of contacts **10C1** causes the tube bias circuit capacitor **38** and also coil **32** to become deenergized after the capacitor **30** discharges. Capacitor **36** is also discharged. Opening of contacts **10C2** deenergizes motor **8** and stops conveyor **2** to prevent damage. Closing of contact **10C3** locks relay coil **10** in through reset button switch **12.** After the material M moves away from conductor **18** the switch **12** is opened to return the circuit to the original condition shown. Switch **12** is then closed and the device is ready for operation after a period of 50 seconds.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. In apparatus for detecting conductive material including a vapor lamp, an electrically conductive means surrounding at least a portion of the periphery of said lamp, an AC power source, a biasing circuit for supplying a high potential DC charge to said lamp, a probe connected to said electrically conductive means to cause said lamp to fire, and means operable when said vapor lamp fires for indicating the presence of conductive material; an improved probe including an electrical conductor adapted to contact said conductive material, a pair of leads the first connected to said electrical conductor and the second terminating adjacent thereto and insulated from the first lead and from said electrical conductor, a capacitor connected in each of said leads, means connecting said capacitors to said electrically conductive means, and a contact in parallel with the capacitor in said first lead adapted to be opened and closed.

2. Apparatus according to claim **1** which includes a timer relay coil for operating said contact, said contact being normally open but closing a predetermined time after said coil is energized.

3. Apparatus according to claim **2** which includes a circuit for supplying current to said timer relay coil, and an indicating lamp in said circuit in parallel with said timer relay coil.

4. Apparatus according to claim **2** which includes a circuit for supplying current to said timer relay coil, a relay coil, means connecting said relay coil to said AC power source, a normally closed switch for controlling flow of current to said relay coil, and means operable by said relay coil to control flow of current to said timer relay coil and said biasing circuit, said normally closed switch being movable to open position to deenergize said relay coil and reset said detecting apparatus.

5. Apparatus according to claim **4** in which said conductive material is carried on a conveyor, and said apparatus includes means operable by said relay coil to stop said conveyor when said tube fires.

6. Apparatus according to claim **2** in which said conductive material is carried on a conveyor, and said apparatus includes means operable to stop said conveyor when said tube fires.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,739,267 Dated June 12, 1973

Inventor(s) Victor R. Bart

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet cancel "[73] Assignee: United States Steel Corporation ". In the title, after "UTILIZING A", insert -- CONTROLLED --. Column 2, line 32, "Devin" should read -- Devil --; line 42, "+5" should read -- ±5% --; line 43, cancel, "1", "3", "5", "6" and "18" and substitute therefor -- 38 --, -- 42 --, -- 44 --, -- 46 --, and -- 48 --, respectively; line 46, cancel, "2" and "20" and substitute therefor -- 34 -- and -- 36 --. Column 3, line 4,

"conditioning" should read -- condition, --.

Signed and sealed this 8th day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

FORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.